Evaluation Design Report: Economic Analysis and Evaluation Services of the Roads and Bridges Activity in Cabo Verde

Original Submission: May 9, 2018
Revised Submission: July 13, 2018

This publication was produced by International Development Group LLC, for review by the Millennium Challenge Corporation.

Economic Analysis and Evaluation Services of the Roads and Bridges Activity in Cabo Verde

Evaluation Design Report

BPA Number: 95332418A0009
Contract Number: 95332418F0085

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LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
AARB	Australian Road Research Board
ADT	Average Daily Traffic
ARE	Economic Regulation Agency in Cabo Verde
BB	Benkelman Beam
CBA	Cost-Benefit Analysis
CBR	California Bearing Ratio
CPIA	Country Policy and Institutional Assessment
CV	Cabo Verde
CVE	Cabo Verde Escudos
DCP	Dynamic Cone Penetrometer
DGTR	General Directorate of Transport and Roads
EAC	East Africa Community
EAR	Evaluability Assessment Report
EDR	Evaluation Design Report
EMC	Evaluation Management Committee
ENAPOR	Empresa Nacional dos Portos
ERR	Economic Rate of Return
ESAL	Standard Axle Load
FAMR	Fundo Autónomo de Manutenção Rodoviária
FWD	Falling Weight Deflectometer
GDP	Gross Domestic Product
GNI	Gross National Income
GOCV	Government of Cabo Verde
GPR	Ground Penetrating Radar
HDM	Highway Development and Management Model
IDA	International Development Association
IDG	International Development Group LLC
IE	Instituto do Estradas
IRB	Institutional Review Board
IRI	International Roughness Index
ITP	Infrastructure and Transport Program
KII	Key Informant Interviews
LOE	Level of Effort
LTPP	Long Term Pavement Performance
LWD	Light Weight Deflectometer
M&E	Monitoring and Evaluation
MCA-CV	Millennium Challenge Account-Cabo Verde
MCC	Millennium Challenge Corporation
MIOTH	Ministry of Infrastructure, Spatial Planning, and Housing
MORABI	Associação de Apoio à Auto-promoção da Mulher no Desenvolvimento
MTC	Manual Traffic Counts
NGO	Non-Governmental Organization

NPV	Net Present Value
O-D	Origin-Destination
PBMCs	Performance-Based Maintenance Contracts
RBA	Roads and Bridges Activity
RED	Roads Economic Decision Model
REMADOR	Rehabilitation and Maintenance Based on Performance and Results Accomplished
RSSP	World Bank Road Sector Support Project
SN	Structural Number
SSA	Sub-Saharan Africa
TSRP	World Bank Transport Sector Reform Project
TT	Travel Time
VOC	Vehicle Operating Costs
VPD	Vehicles Per Day

I. INTRODUCTION AND BACKGROUND

1.1 COUNTRY CONTEXT

After a two-year consultation process, the Millennium Challenge Corporation (MCC) and the Government of Cabo Verde (GOCV) signed a five-year, $110 million Compact in July 2005. The Compact consisted of three different project areas – infrastructure, private sector development, and watershed/agriculture support. The "Compact Goal," as stated in Article 1 of the Compact, is to advance the goal of economic growth and poverty reduction in Cabo Verde (CV).

Under the Infrastructure Project, the Roads and Bridges Activity (RBA) aimed to achieve basic connectivity and improve mobility in two targeted island networks by reducing road network gaps and ensuring all-weather traffic access to markets and services. With an investment cost of $27.7 million, the RBA improved three roads (totaling approximately 39 km) on the island of Santiago and four bridges on the island of Santo Antão with 1.3 km of access road. Such investments were also closely aligned with the World Bank's support to infrastructure in Cabo Verde in 2005 which sought "improved and sustainably maintained road networks [to] underpin economic growth, poverty reduction and national integration strategies."[1]

1.2 OBJECTIVE OF THE REPORT

On September 29, 2017, MCC issued a contract to International Development Group LLC (IDG) to conduct an Economic Analysis and Independent Evaluation Services in Support of the Cabo Verde Roads and Bridges Activity. The evaluation is designed to understand the impact of the MCC-funded RBA on Cabo Verde's economic growth. The objective of the Evaluation Design Report (EDR) is to present the proposed methodology to address the research questions in detail.

In this report, the team will: i) provide an overview of the Compact and RBA, ii) present the recommended quantitative and qualitative evaluation design for each Research Area, and iii) summarize administrative issues of the evaluation. The present EDR incorporates feedback and recommendations from MCC and stakeholders in CV.

[1] World Bank. 2005. Cape Verde Road Sector Support Project Appraisal Document, April 22, 2005, page 4. http://documents.worldbank.org/curated/en/368811468236642262/Cape-Verde-Road-Sector-Support-Project

II. OVERVIEW OF THE COMPACT AND THE INTERVENTION EVALUATED

2.1 OVERVIEW OF THE PROJECT AND IMPLEMENTATION PLAN

2.1.1 Original Project Description

When the Compact took effect in July 2005, an autonomous body, the Millennium Challenge Account Cabo Verde (MCA-CV), was established by the GOCV to implement the projects under the Compact. At the design stage, around $82.7 million was allocated for the Infrastructure Project, which included two activities, a Port Activity and the RBA. The Port Activity was designed to improve the Port of Praia in order to increase available space for cargo operations and develop high-efficiency terminals. The port rehabilitation was also designed to meet the goal of integrating internal markets and reducing transportation costs in the medium-term to long-term.

Within the Infrastructure Project, the RBA was "designed to achieve basic connectivity and improve mobility on two targeted island networks by: (i) closing network gaps and/or (ii) ensuring all-weather and reliable access both to intra-island markets and services, as well as transportation linkages on the targeted islands."[2] The RBA included the following activities:

Road Improvement Activity

The original five segments to be financed in Santiago under the roads improvement activity were:

- Orgãos-*Pedra Badejo* (10.0km) – Rehabilitation from cobblestone to asphalt standard.
- *Cruz Grande-Calhetona* (13.7km) – Rehabilitation from cobblestone to asphalt standard.
- *Assomada-Porto Rincão* (15.6km) – Rehabilitation and reconstruction to asphalt standard for the first 7km and cobblestone standard for the remaining 9km.[3]
- *Volta Monte-Ribeira Prata* (14.4km) – Rehabilitation and reconstruction to improved cobblestone standard.
- *Fonte Lima – Joao Bernardo/Librao* (8.4km) – Rehabilitation and reconstruction to improved cobblestone standard.

Bridge Improvement Activity

The bridge improvement activity was designed to construct four bridges on Santo Antão island. The projects are:

- *Vila das Pombas and Liaison Eito* – Construction of two small bridges and construction of a 1.3 km access road to provide access to the town of Paul.
- *Ribeira Grande and Ribeira Torre* – Construction of two small bridges and protection works along the river banks.

In the case of the bridges at *Vila das Pombas* and *Liaison Eito*, the construction of the bridges was intended to allow for reliable access to two major towns. The access road was located in the river

[2] MCC Compact Agreement.

[3] The GAO document of July 2011 inferred that all upgrading was done to asphalt concrete standard, and this was further confirmed by MCC during the meeting on November 17, 2017 in which MCC indicated no sections had been rehabilitated in cobblestone. The team also confirmed that most of the Assomada and Porto Rincão section was upgraded to asphalt concrete standard. More description on implementation is available in the following sections.

bed which renders travel impossible when it rains. The construction of the bridges and of the access road was expected to result in cost savings due to reductions in daily travel time and vehicle operating costs. It aimed to allow for farmers' agricultural products, including locally grown sugar cane, to be more easily transported from the area.

The two bridges at *Ribeira Grande* and *Ribeira Torre* are located at the confluence of two rivers and four roads. The bridges were designed to allow this area to be more passable during the rainy season.

Additional Activities: Environment and HIV Prevention and Education
Additional activities associated with the RBA included environmental activities and HIV/AIDS education and prevention activities. Environmental monitoring included ensuring appropriate assessments were conducted during construction and operation; compliance with regulation related to sand extraction and protection of forested areas, biodiversity, natural resources and/or socioeconomic activity; and identifying and proposing adequate sites for deposition of stockpiles material to avoid risk of contamination to surrounding lands and waterways.[4]

2.1.2 Description of Implementation

Road Improvement Activity
In January 2008, MCC and MCA-CV canceled the construction of *Volta Monte-Ribeira Prata* and *Fonte Lima-Joao Bernardo/Librao* roads – the cobblestone improvement road sections. According to MCC, the decision to cancel the rehabilitation of the two roads was a result of construction delays and budget shortfalls. The selection criteria for choosing road segments to cancel included lower expected Economic Rate of Returns (ERRs).[5] The *Volta Monte-Ribeira Prata* and *Fonte Lima-Joao Bernardo/Librao* roads originally had expected lower ERRs due to low traffic volume (9 and 32 vehicles respectively per day respectively as compared to the other three roads with a minimum of 300 vehicles per day). Therefore, during the design of the Compact, the two roads were identified as rural access and "social" roads, where the main objective was to ensure basic minimum access requirements to isolated populations. Cost effectiveness method was initially used to justify investment on these two roads and were subsequently canceled from the Compact.

The re-scoped road improvement activity rehabilitated three road segments on Santiago Island to reduce transport costs and increase integration of the internal market. The segments financed under the road improvement activity, thus, were: *Orgãos-Pedra Badejo (Road#1), Cruz Grande-Calhetona (Road#2),* and *Assomada-Porto Rincão (Road#4).* The project was reduced from an initial target of 63 km of roads to a final target of 39.3 km of roads on the Santiago island. The final result was 40.6 km of roads when including the 1.3 km of an access road constructed in association with a bridge on Santo Antão island (*Liaison Eito*).

The first two road segments are principal secondary roads establishing key east-west links in the island. *Orgãos-Pedra Badejo* is a primary east-west link in the southern part of the island. The road is located in one of the most agriculturally productive areas in the country, known for providing produce to the capital city of Praia. The original cobblestone surface was in poor

[4] Pascal De Giudici, Environmental Specialist, The Louis Berger Group. Rehabilitation and Construction of Roads in the Island of Santiago: R1, R2, R3, R4, R5 Environmental Supervision.
[5] Conversation with Barry Deren, MCC Economist, November 17, 2017.

condition with inadequate drainage and insufficient protection of the side slopes. *Cruz Grande-Calhetona* is also a primary east-west link in the center of the island and it connects the two-major north-south corridors, both of which connect to the northern town of *Tarrafal*. The original cobblestone road was in degraded condition and MCC rehabilitated the road with a new asphalt surface. In the third case, the road segment linking *Assomada* to *Porto Rincão* is the only connector of an isolated fishing area and seven communities to the rest of the island. The project was initially scoped to consist of asphalt improvement for the first 7 km west of *Assomada*, and cobblestone reconstruction improvement for the remaining 9 km to *Rincão*. However, strong objections by locals in *Rincão* resulted in most of the road being rehabilitated using asphalt; the one exception is an approximately 1 km segment just east of *Achada Grande* that is still cobblestone.

Table 2.1 Road Sections and Road Length

Section	Island	Road Section	Improvement	Length (km)
Road #1	Santiago	*Orgãos - Pedra Badejo*	Rehabilitation from cobblestone to asphalt standard	10.0
Road #2		*Cruz Grande-Calhetona*	Rehabilitation from cobblestone to asphalt standard	13.7
Road #4		*Assomada-Porto Rincão*	Rehabilitation from cobblestone to asphalt standard[6]	15.6
GRAND TOTAL				**39.3**

Asphalt rehabilitation for the roads was intended to improve the road conditions and reduce VOCs. In addition, the proposed road improvements aimed to help link isolated agricultural and fishing communities to the main network. Among other improvements, the improved roads intended to help facilitate the movement of goods and services, including agricultural products and fishing products, allow for labor mobility and development of the tourism market, and provide all year access to areas of the country that may be cut off during the rainy season as well as reduce dust during the dry season.

Bridge Improvement Activity

Under this activity, MCC's funds were used to finance the construction of four bridges in Santo Antão and a 1.3 km access road. The *Ribeira Grande* and *Ribeira Torre* section included the construction of two small bridges in Ribeira Grande and Ribeira Torre in conjunction with flood protection works along the river banks. The two small bridges helped connect towns in Santo Antão during the rainy season, especially the following three towns: Ponta do Sol (the administrative center of the Municipality of Ribeira Grande), Ribeira Grande (with main commercial centers, farmers, houses etc.), and Paul. The *Vila das Pombas* and *at Liaison Eito* section included the construction of two bridges in Paul and an access road to Eito to allow reliable access to two major towns during floods. The construction of these two bridges in Paul and the access road to Eito were considered important to maintain accessibility to the administration services in Paul as well as allow farmers to easily transport agricultural products between Ribeira Grande and the Santo Antão port, Porto-Novo.

[6] Except the Chão de Tanque – Achada Grande sub-section that was rehabilitated in cobblestone (a 1-km long steep gradient segment).

All bridges are approximately 40 m long, with the exception of the Ribeira da Torre bridge, which is approximately 60 m long (Table 2.2).[7]

Table 2.2 Bridge Sections and Length

Bridge #	Bridge Section	Improvement	Length (km)
1	*Road Paul – Ribeira Grande*	New construction	0.04
2	*Ribeira Grande*	New construction	0.04
3	*Ribeira da Torre*	New construction	0.06
4	*Bridge on access road to Eito*	New construction	0.04
GRAND TOTAL - BRIDGES			**0.18**
N/A	*Access road to Eito*	New construction to cobblestone standard	1.30
GRAND TOTAL - ROADS			**1.30**

Additional Activities: Environment and HIV Prevention and Education

In the area of HIV/AIDS education and prevention for workers on the road and bridge construction sites, MCA-CV, working in partnership with the Ministry of Infrastructure and Transport and the Executive Secretariat of CCS SIDA (Coordination Committee for the Combat against AIDS and Sexually-Transmitted Diseases) entered into partnership agreements with local organizations on the islands of Santiago and Santo Antão to conduct "Campaigns of Sensitization." Firms - *Associação de Apoio à Auto-promoção da Mulher no Desenvolvimento* (MORABI) and URGIMED, Lda. - were contracted to conduct campaigns aimed at 1) increasing awareness through information, education and communication; 2) facilitating access to HIV blood tests for workers through referral for anonymous and voluntary testing; and 3) distributing prevention and educational materials. The organizations reached hundreds of workers through their activities. They held information sessions at worker sites to provide information about HIV and prevention methods and the importance of testing. Counseling sessions and testing were made available and hundreds of materials including condoms, and pamphlets, as well as other items were distributed to increase awareness.[8]

2.1.3 Intended Beneficiary/Participants

MCC defines beneficiaries as individuals who experience better standards of living, primarily through enhanced income. According to the MCC Compact, the principal intended beneficiaries of the RBA are expected to be rural and urban populations in the islands of Santiago and Santo Antão where the interventions occurred. The groups of beneficiaries include "families, farmers, businesses, non-governmental organizations and social-service providers and communities located along the roads or bridges proposed for improvement and construction." MCC further categorizes beneficiaries as direct and indirect. Direct beneficiaries are defined as "people living in communities within 2 kilometers of the roads" while indirect beneficiaries are defined as "all residents on the islands of Santiago and Santo Antão."[9]

[7] The Terms of Reference for the present evaluation indicate that the two bridges at Ribeira Grande total 200 m, however, during the first mission to Cabo Verde, the Evaluation Team observed that these two bridges are approximately 40 m each (around 80 m combined).

[8] Millennium Challenge Account – Cape Verde. Supervision of the construction of four bridges in Santo Antão and access road to Eito, Monthly Report, July 2009.

[9] MCC Cape Verde 2005-2010 Compact, Monitoring and Evaluation Plan, Version III: October 11, 2010

Following MCC's definition, the main intended direct and indirect beneficiaries are primarily families, farmers, and businesses in Santiago and Santo Antão. Families and farmers will experience increased income by being closer to the market to sell or acquire their goods and having increased labor mobility. Businesses in some sectors, such as tourism, which is an important engine of growth in Cabo Verde, will see a rise in income due to more reliant transport of labor to work in the industry.

MCC defines participants as individuals who take part on an MCC-funded project but do not experience an increase in income. These participants include the GOCV (national and local), as well as non-governmental organizations (NGOs), donor organizations, local contractors, engineers, consultants, transport service providers, and traders. However, it is unclear whether some parties belong in the beneficiaries or the participants group. For example, residents who use public transportation on the road are beneficiaries of cost savings only if the transportation operator passes some of the cost savings in the form of lower fares to his or her customers. Other benefits from the rehabilitated roads, such as improved safety and increased comfort, would not necessarily increase income and therefore disqualify this group as a beneficiary. Similarly, a transport service provider may experience an increase in income only if the transport service owner/employer passes the increase in revenue to the employee in the form of increased income.

2.1.4 Geographical Coverage

MCC's RBA were implemented on two islands of Cabo Verde: Santiago and Santo Antão (See Figures 2.1 and 2.2 below).[10]

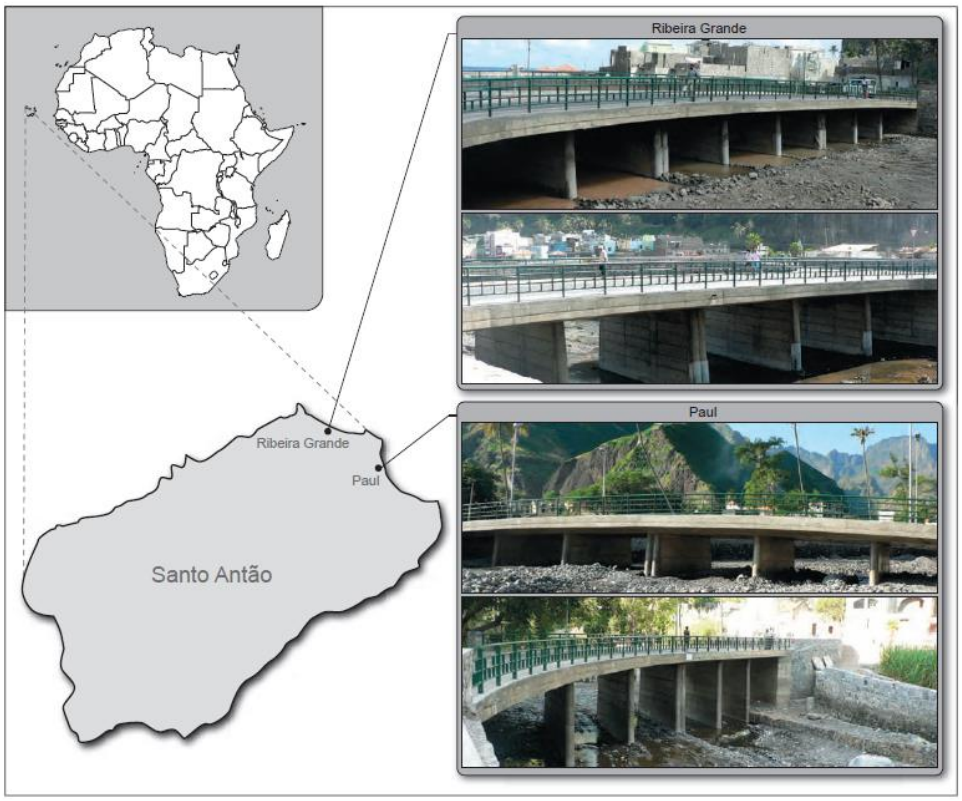


Figure 2.1 Map of MCC Rehabilitated Bridges in Santo Antão

[10] Figures from the 2011 GAO report titled *"MCC Compact in Cape Verde and Honduras Achieved Reduced Targets"*

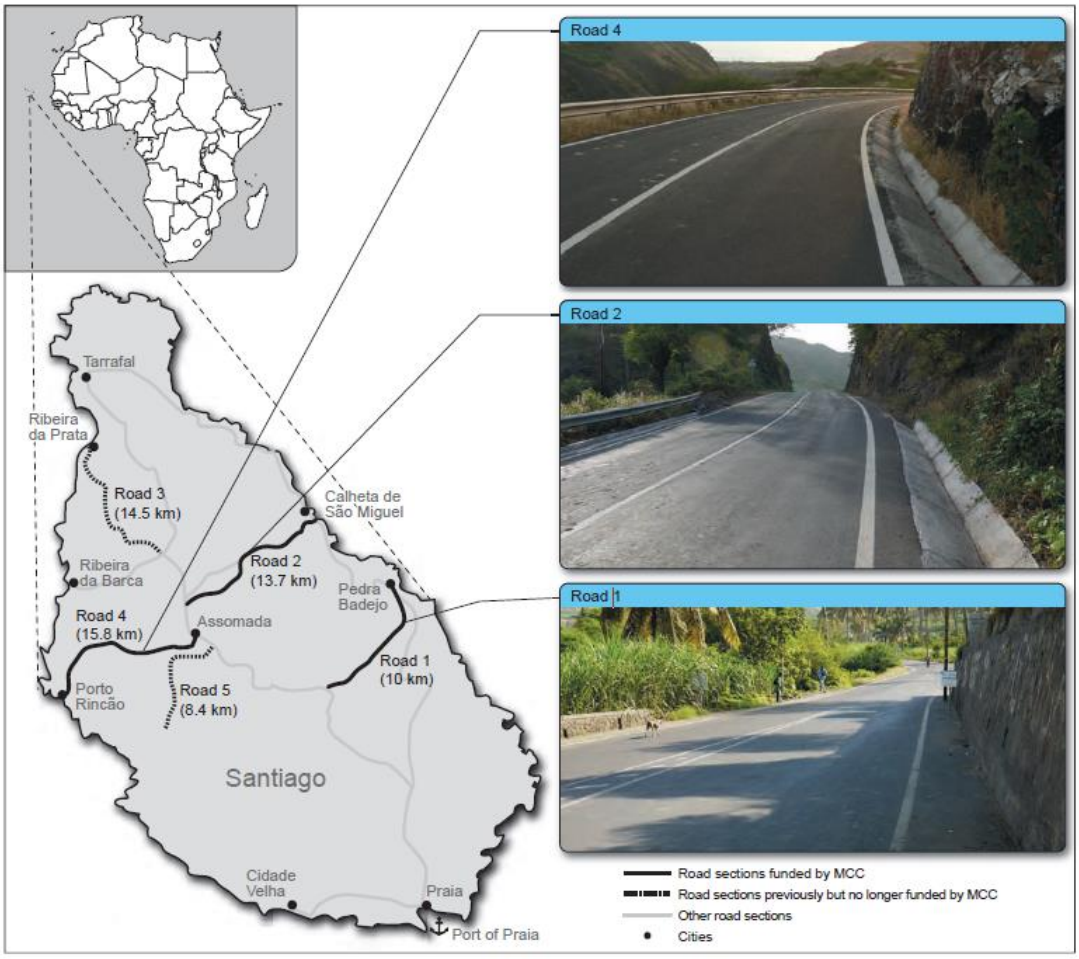


Figure 2.2 Map of MCC Rehabilitated Roads in Santiago

2.2 PROGRAM LOGIC/THEORY OF CHANGE

The goal of MCC's Compact with the GOCV as outlined in Article 1 is "to help facilitate poverty reduction through economic growth." Transport infrastructure is often a crucial factor in determining the location and level of economic growth within a country. Especially for a country with multiple islands like Cabo Verde, the transportation network of ports and the roads connecting to those ports is an essential asset for economic development, linking residents to jobs and social services and consumers and producers to markets. Some studies suggest that the provision of rural roads and transport services are closely linked to improvements in rural health, education, agricultural production, as well as to annual per capita income.

The Infrastructure Objective, defined in Article 1 of the Compact, is to "increase integration of the internal market and reduce transportation costs." The objective of the Infrastructure Project is clearly stated and aligns with the problem diagnostic of Cabo Verde's road infrastructure. Within the Infrastructure Project, the RBA was "designed to achieve basic connectivity and improve mobility on two targeted island networks by: (i) closing network gaps and/or (ii) ensuring all-weather and reliable access both to intra-island markets and services, as well as transportation linkages on the targeted islands." Cabo Verde's road density is relatively high and rural road

access is limited by poor conditions. In 2005, 56 percent of Santiago's roads were paved, and 75 percent were in poor condition.

The Infrastructure Project also contains an initiative to improve the Port of Praia in order to increase available space for cargo operations and develop high-efficiency terminals. This is also designed to meet the goal of integrating internal markets and reducing transportation costs in the medium-term to long-term.

An analysis of the national surveys conducted on household income in 1988-89 and 2001-02 and the national 2007 United Survey of Core Welfare Indicators, documented that poverty in Cabo Verde is most severe in rural areas. 72 percent of the country's poor reside in rural areas and 30 percent of the rural population lives in absolute poverty, exceeding the 12 percent of the urban population that live in absolute poverty. This has been linked to the transition to a service economy, led by the tourism industry which is concentrated in urban areas that "benefited from large public infrastructure investments." Improving the transportation network would potentially confer benefits to multiple groups including families, farmers, fishermen, and businesses. By increasing internal connectivity, residents would have increased opportunities for mobility and the flow of goods and services would improve. Improving the internal road network could thereby benefit the market for labor, goods, and services. It could also lead to improved outcomes in health and welfare, if access to social services improves.

The project logic for the RBA is shown below in Figure 2.3. The chart describes the expected causal chain of events leading from the RBA's inputs and project activities to outputs, to short-term outcomes, and to the achievement of long-term outcomes leading to project objective.

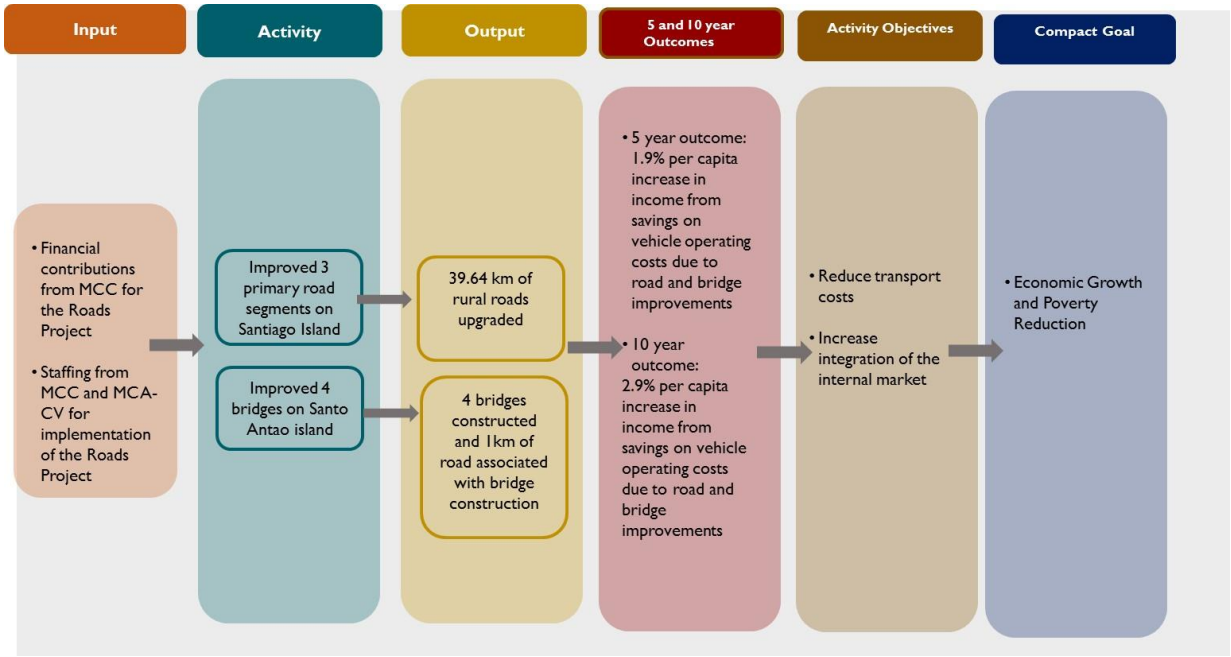


Figure 2.3 Roads and Bridges Activity Logic[11,12]

[11] This graphic is based on the "Project Logic Diagram" in MCC-RFQ-0073/Attachment 1.
[12] Note that the logic model does not include additional activities - Environment, HIV Prevention and Education – but focuses on the roads and bridges improvement activities.

As Figure 2.3 above indicates, the project inputs were defined by the five-year Compact between MCC and the GOCV signed in 2005. The MCA-CV/MCA was the designated entity that would oversee the Compact during the five-year implementation period. Together, the MCC and MCA provided staff support for the project.

III. EVALUATION DESIGN OVERVIEW

3.1 EVALUATION TYPE

In September 2017, IDG was contracted by MCC to conduct an economic analysis and a performance evaluation of the Compact's Roads and Bridges Activity. The evaluation of the MCC Cabo Verde Roads and Bridges Activity is mainly two-fold: 1) an economic analysis (Research Area 1) to understand the costs and benefits of the MCC-funded roads, and 2) performance evaluations of the road maintenance and road usage patterns conducted to complement and enhance knowledge gained through the economic analysis (Research Areas 2 and 3).

The *economic analysis* consists of one research area as follows:

Research Area 1 tests the economic viability of MCC-funded roads and bridges by conducting a cost-benefit analysis (CBA) to estimate the ERR and net present value (NPV) of the roads and bridges. The CBA assessing the effects of the roads will employ the Roads Economic Decision (RED) model, an analytical tool used to conduct CBA for roads. The economic analysis for the bridges will be conducted by deriving benefits from time that would otherwise have been lost due to road impassibility through extreme weather events and destroyed bridge infrastructure. Post-Compact CBA re-evaluates the validity of the initial assumptions made prior to the Compact. An updated ERR of the MCC-funded roads and bridges will inform MCC on the economic viability of relatively large roads and bridges infrastructure projects.

The *performance evaluations* are centered around three thematic areas as below[13]:

Research Area 2 will evaluate the road maintenance regime within Cabo Verde to test the sustainability of improvement in road infrastructure. The analysis will improve MCC's assumption on post-Compact maintenance and project-life assumptions about its infrastructure investments. In addition, the evaluation will examine the effect of MCC's efforts in improving the road maintenance practices in Cabo Verde under the Roads Project.

Research Area 3 is a study of road users, based on origin-destination (O-D) surveys on segments of the MCC-funded roads. The data collected from the O-D surveys will inform the RED model. Information such as the cost and duration of the trips and value of the goods being transported will be analyzed. The feasibility of surveying public transport users in parallel with the O-D surveys to get a full picture of the users and beneficiaries of the road improvements will also be considered. This research area is intended to understand qualitative information on the road users and their travel patterns.

[13] The initial scope of work from MCC included an additional Research Area (Research Area 4), which intended to conduct an analysis of both formal and informal transportation market structure. This research was intended to to understand how cost savings from road improvements have passed on to transport consumers who do not own their own vehicles. While MCC did not directly work in this area, analysis of the formal and informal institutions of the transportation market would have informed whether vehicle operating cost savings were passed on to road users who do not own their own vehicle, such as fisherman and farmers transporting their goods to market and public transportation users.

The three research areas, collectively, will inform MCC on its future project design, monitoring, and implementation of roads and bridges projects and/or other relatively large infrastructure projects.

Evaluation Questions[14]

Below are the research questions that will be addressed as part of the evaluation:

Research Area 1

1) What is the economic return – calculated in terms of vehicle operating cost (VOC) savings and travel time (TT) savings – of the road investment? [Core]

Research Area 2

2A) What are the relevant road authority's current maintenance practices and what is the likelihood that MCC's investment will remain adequately maintained for the life of the investment? Based on this assessment, what set of maintenance assumptions should be used in the HDM-4 model to yield the best estimate of the costs and benefits of the road investment? [Core]

2B) In cases where MCC invested in improving maintenance practices or included a maintenance Conditions Precedent in the Compact (applicable to Cabo Verde), what were the effects of those efforts and why? [Core]

Research Area 3

3A) Who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long does it take to move along key routes? [Core]

3.2 EVALUATION DESIGN OVERALL APPROACH

Key Outcomes	Data Source	Data Type
Research Area 1: Cost-Benefit Analysis of MCC-funded Roads		
• Direct cost savings to road users • Improved quality and reliability of roads	Road structure and conditions Road users	Quantitative - Cost benefit analysis using RED
Research Area 2: Road Maintenance		
• Strengthened capacity and effectiveness of government agencies	Local stakeholders Relevant official and project documents	Quantitative - Road roughness survey - Surface distress survey Qualitative

[14] The initial scope of work from MCC included the following three additional Supplemental evaluation questions, which were later removed from the evaluation based on discussion with MCC:

- Evaluation Question 2C) What political, and economic incentives are shaping road maintenance decisions in the country? And what other key factors are influencing actual maintenance practices? [Supplemental]
- Evaluation Question 3B) Have road usage patterns changed, in terms of who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long it takes to move along key routes? [Supplemental]
- Evaluation Question 4) How is the transportation market structured and what is the likelihood that VOC savings will be passed on to consumers of transportation services? [Supplemental]

Key Outcomes	Data Source	Data Type
• Improved quality and reliability of roads • Improved sustainability of national road network		- Key Informant Interview (KII) - Review of relevant documents
Research Area 3: Study of Road Usage Patterns		
• Improved access to health and education services • Improved access to agricultural and non-agricultural markets	Road users Public transport users	Quantitative - O-D survey - Public transport user survey

3.3 TIMEFRAME OF EXPOSURE

Realization of impact and benefits of road construction projects depends on the extent of change and economic potential of the project impact area. There is no clear evidence to indicate when to collect data for HDM-4 or RED after a road is completed. In general, "transport experts agree that it is unrealistic to expect to see immediate impacts on high-level outcomes, and that a few years are required for those changes to manifest."[15] While not in a developing country context, a study of 13 improved roads in England shows that the roads experienced an average of 7 percent increase in traffic, as compared to average background growth, between 3 to 7 years after opening.[16] Based on in this report and other relevant experience, the team believes that improving a congested road will bring out most of the impact within 1-2 years whereas constructing a new road to areas without good access will take 1-2 years to start to see the early impacts and 3-7 years to see larger impacts and 8 or more years to see the full impact.

Based on the M&E Plan (October 2010), the Santiago roads were completed in January 2010 while the Santo Antão bridges were completed in October 2009. Assuming that the data collection occurs between November 2018 – August 2019, the exposure period of the RBA for the evaluation is around 106 months to 118 months (approximately 9 - 10 years.)

[15] MCC, Principles into Practice, Lessons from MCC's Investments in Roads, November 2017.
[16] Lynn Sloman, Lisa Hopkinson, and Ian Taylor, Campaign to Protect Rural England, The Impact of Road Projects in England, March 2017.

IV. EVALUATION DESIGN – RESEARCH AREA 1: ENGINEERING ANALYSIS AND ECONOMIC MODEL

4.1 EVALUATION QUESTIONS

1) What is the economic return – calculated in terms of VOC savings and TT savings – of the road investment? [Core]

The purpose of this question is to determine the economic viability for MCC's RBA by comparing the final project costs and benefits to road users. The Evaluation Team will also examine in depth the executed design of MCC's RBA and provide recommendations, if necessary, to help improve future programming and maximize the economic returns.

The economic return of an infrastructural investment – in the case of the RBA activity, road upgrading or improvement and bridge construction – represents the fundamental benchmark that facilitates high-level decision makers to approve or allocate public sector funds into a particular investment. Fiscal and budgetary planning is done under the auspices of the Ministry of Finance, usually within a three-year Medium-Term Expenditure Framework guided by an overarching long-term development plan or Vision 2030 document. As such, funds for capital investment purposes need to be distributed across various sectors of the economy. Transport infrastructure needs therefore to compete with sectoral funding needs in education, health, energy and water in addition to the requirements of defense, public administration and other governmental services. This economic return is a quantitative value that is conventionally expressed in two key indicators: NPV and ERR.

4.2 EVALUATION APPROACH

The approach used for the proposed economic evaluation comprises both primary and secondary data collection efforts followed by rigorous data analysis that utilizes established modeling/analytical tools.

4.2.1 Summary of Existing Data

Primary data collection involves carrying out field surveys within the project area whereas secondary data collection appertains to accessing and obtaining data from existing sources such as published or internal reports from various governmental ministries, departments, agencies and state-owned enterprises as well as international development partners and financing institutions. For purposes of this evaluation, secondary data sources are:

- Historical engineering records prepared under MCC's supervision during the Compact;
- Excel file with Roads Economic Decision (RED) model results and methodology report;
- Maintenance interventions (maintenance policy, historical maintenance activities and practices obtained from the Instituto de Estradas (IE));
- Historical traffic counts; and
- Macro-economic indicators and various sectoral statistics (agriculture, fishing, tourism).

Secondary MCC data sources reveal that the economic evaluation of three road sections in the Santiago island was carried out using the RED model. The use of RED appears reasonable; traffic volumes were low and were subject to seasonal disruptions prior to the rehabilitation.

However, the inputs for the RED model are unavailable. The only document received by the IDG team is an Excel file reporting on the results of the RED model, dated 09/05/2005.[17] The team will therefore only be able to do a "backward" analysis applying growth rates inversely to arrive at 2005 traffic levels.

The Evaluation Team also has available the ERR results and assumptions (but no inputs) from the baseline assessment conducted by the World Bank. The assessment considered three road improvement technical solutions for higher trafficked roads: cobblestone, double surface treatment, and asphalt-concrete surfacing.[18] However, there was consistently a small difference in the rate of return between cobblestone and double surface treatment, so the added cost of double surface treatment was not justified by substantial VOC benefits. The added cost of asphalt concrete pavement compared with cobblestone pavement was compensated by higher savings in VOCs, resulting in highest rates of return, above 16 percent for all considered projects. Therefore, the *Orgãos-Pedra Badejo* and *Cruz Grande-Calhetona* roads improvement to asphalt concrete pavement was considered economically justified.

The sensitivity analysis showed that the results were more sensitive to a reduction in VOC than to an increase in investment costs. The rates of return were higher than 12 percent for both increased cost and decreased benefit scenarios for all considered projects. For the worst-case scenario (cost +20 percent; benefits –20 percent) the ERR were between 10.1 percent (*Orgãos-Pedra Badejo*) and 12.8 percent (*Cruz Grande-Calhetona*).

For roads with very low traffic, the least cost option was sought. In addition to three solutions that were evaluated formally, the gravel road option was considered but was deemed not appropriate in Cabo Verde because of mountainous terrain, higher risk of wash outs, and higher routine maintenance costs. Therefore, the cobblestone option was judged to be the least cost alternative. In order to overcome the shortage of skilled stone workers and lengthy time required for cutting new stones, it was planned to include a program of recycling stones from roads being upgraded from cobblestone to asphalt concrete into the program.

Initially during project design, a mixed solution was recommended for the *Assomada-Porto Rincão* road, because of substantially different traffic on two sub-sections. A 7 km-long section with higher traffic was designed to be improved to asphalt concrete pavement and cobblestone for the remaining lower traffic section of the road. However, various post-Compact documents and visual inspection in Cabo Verde confirmed that a revised pavement design was later accepted that included asphalt concrete pavement on the entire road, except for a section from *Chao de Tanque*

[17] This Excel file contains four worksheets relating to User's Guide, Project Description, Project ERR and Subproject ERRs.
[18] Cape Verde Monitoring & Evaluation Plan, Revised December 11, 2008.

to *Achada Grande* where cobblestone pavement was used because of high longitudinal slope (900 m).[19]

A cost-benefit analysis for bridge projects was conducted using quantified non-VOC economic benefits, based on income loss due to transportation blockage, since the main objective of these projects was to remove a critical transport constraint, which had a profound effect on economic activity. The major roads leading to the bridge sites had cobblestone surface with an acceptable level of service and average daily traffic ranging from 410 to 760 vehicles per day (vpd). The least-cost option considering high traffic levels on feeder roads was considered to be a box culvert design.

A strong ERR above 17 percent was obtained for both bridge projects. The sensitivity analysis for the worst-case scenario (cost +20 percent; benefits –20 percent) showed that the economic rate of return was still above 12 percent for the *Ribeira Grande* and *Ribeira Torre* project and marginally below 12 percent for the *Vila das Pombas* and *at Liaison Eito* project.

Following the project implementation start, it was determined that the designs were of poor quality and MCA-Cabo Verde decided to revise them to a higher standard, which led to increased costs. As a result, MCC and MCA-Cabo Verde reduced the scope of the activity[20] and dropped two roads, which dropped the ERR to 13.6 percent for the overall RBA.[21]

4.2.2 General Methodology

The CBA compares the costs (capital and recurrent) of road investment with the resulting benefits to road users. These benefits primarily include reduction in VOC and TT savings, as well as future maintenance savings. Reductions in accident costs will also be evaluated if secondary data sources are available.[22]

Travel time savings, VOCs, and accident costs result from combinations of 1) improvements in road standard/design, alignment and surface condition (notably roughness), 2) future maintenance savings from improvements in road surface condition, and 3) structural strength. The improvement scheme is compared to a base or *do-minimum* alternative in which the unimproved road continues to be maintained in line with established procedures.

The RED model or the HDM-4 model are both appropriate tools for establishing the economic evaluation for the project road investment. HDM-4, originally developed by the World Bank, is now accepted as the premier model for the economic evaluation of road rehabilitation and improvement schemes in developing countries. HDM-4 model allows modeling of (1) road deterioration as a factor of road construction and maintenance, traffic loadings, and climatic

[19] Currently, there is no documentation available to clearly justify the change in the design from cobblestone to asphalt standards for a lower traffic volume section of the *Assomada-Porto Rincão* road. However, multiple interviews in Cabo Verde have indicated that the decision to upgrade the road design was mainly a political decision.
[20] Millennium Challenge Corporation Compacts in Cape Verde and Honduras Achieved Reduced Targets, GAO Report to Congressional Committees, July 2011.
[21] MCC Cape Verde 2005-2010 Compact, Monitoring and Evaluation Plan, Version III: October 11, 2010
[22] During the EDR Stakeholder Workshop held in Cabo Verde in February 2018, GOCV stakeholders have asked whether the economic analysis could also study the effect of the RBA project on road safety (e.g. reduction in vehicle accidents). The IDG Evaluation Team will aim to assess this if secondary data is available.

conditions, and (2) road user costs as a function of traffic and roadway factors, road deterioration and subsequent maintenance and rehabilitation/construction, over the analysis period. It allows to explore various road construction and maintenance strategies. The RED model is a simplified spreadsheet-based model, which performs a similar function to HDM-4 but uses an average road condition over the analysis period instead of simulating the road condition for each year of the analysis period. The RED model is considered the more appropriate tool when data, particularly engineering data, is limited.

To inform the decision of which approach to model and data collection is best, the Evaluation Team considered four options, each one providing incrementally greater level of data collection and/or complexity of modeling and also requiring incrementally greater cost. The four options considered are as follows:

- *Option 1*: includes deflection survey, and the team will use HDM-4 to estimate the ERR, using the as-built drawings and deflection to estimate the deterioration model.
- *Option 2*: the team will use RED to estimate the ERR, and will collect deflection data to accurately estimate the deterioration model using either HDM-4 or RONET.
- *Option 3*: excludes deflection survey, and the team will use HDM-4 to estimate the ERR, using the as-built drawings to estimate the deterioration model.
- *Option 4*: excludes deflection survey, and the team will use RED to estimate the ERR.

Options[23]	**Option 1**	**Option 2**	**Option 3**	**Option 4**
	HDM-4 with deflection survey	RED with deflection survey	HDM-4 without deflection survey	RED without deflection survey
Model	HDM-4	RED	HDM-4	RED
Data collection/analysis (deflection, geotechnical)	• Geotechnical analysis (using as-built drawing) • Deflection survey	• Deflection survey	• Geotechnical analysis (using as-built drawing)	• N/A
Estimated range of ERR[24]	**+/- 0.5% points**	**+/- 1% points**	**+/- 1% points**	**+/- 2% points**
Estimated incremental cost (labor, data collection costs), compared with Option 4[25]	**$ 47,235**	**$ 41,538**	**$ 11,118**	**$ -**

The following table presents our summary results and conclusions, showing an estimated level of precision of the ERR and estimated incremental cost for each option.

All options presented above will estimate the ERR with varying levels of precision based on the rigor of the data collection methodology. In order to understand the estimated ERR range expected for each option, the team calculated a preliminary estimate of the ERR using the RED model and

[23] All options exclude primary data collection of geotechnical data (DCP/test-pits).
[24] Estimated range of ERR is based on a back-of-the-envelope RED analysis and the expertise of the team.
[25] Note that the estimated incremental cost for Option 1 is still within the total budget for Option Period IA.

available existing data. Based on this ERR estimate, the team calculated the ERR range for Option 4 by applying a sensitivity-analysis approach to vary key inputs to the model across a range that seemed reasonable given the current road conditions. Based on the RED modeling results, the team then used their best judgement to determine the estimated range of ERR for Options 1, 2, and 3. For instance, Option 2 will likely provide an ERR estimate that is within + or – 1 percentage point of the actual ERR. The estimated ranges of ERR are partially based on the team's subjective judgment and should not be considered as a rigorous confidence interval.

The Evaluation Team calculated the additional labor from the team members and data collection costs associated with Options 1, 2, and 3. The costs presented in the table show incremental costs estimated for each option in addition to the cost associated with Option 4. The estimated costs do not include some Other Direct Costs (ODCs) associated with data collection and therefore should not be considered as the final budget for each option.

The Evaluation Team believes that all four options would produce results that would be sufficiently rigorous and professional for the evaluation's purposes, with each option providing incrementally greater rigor at incrementally greater cost. Recognizing the emphasis MCC places on spending resources carefully and based on this back-of-the-envelope analysis, the Evaluation Team will adopt Option 4 (RED without deflection survey) in general for the economic evaluation of the three road sections rehabilitated with MCC funds on Santiago Island. While it is important to note that Option 4 may yield an estimated ERR that is not as precise as the other options, the estimated ERR from Option 4 will be sufficiently accurate and useful based on the current road condition and road usage of MCC roads. The RED model will be applied for a post improvement 20-year appraisal period, the standard application for road cost benefit studies.[26]

For the bridges component of the evaluation, the analysis will be based on the calculation of economic benefits of road users having uninterrupted access all year round to the towns connected by the new bridges compared with periods of inaccessibility due to heavy rainfall and torrential river flows.

The output of the CBA consists of measures of economic viability, principally NPV and ERR. Basic economic viability is generally considered to be achieved if NPV is positive and ERR is greater than the specified hurdle rate, as a percentage.

4.2.3 Summary of Data Collection Options

Table below provides a summary of the evaluation design, data collection options where relevant, and the proposed approach for data collection (shaded in light green). Details of the methodology for each data collection effort are provided in sections that follow.

[26] Relevant details are set out in the preliminary HDM-4 Calibration Report document.

	Data	Type	Annex J Requirements	Option 1 HDM-4 with deflection survey	Option 2 RED with deflection survey	Option 3 HDM-4 without deflection survey	Option 4 RED without deflection survey	Notes
1	Deflection Measurement Survey	Santiago Roads	FWD testing at 1-km intervals	Benkelman Beam testing at 200-m intervals	Benkelman Beam testing at 200-m intervals	This survey will not be conducted but the team will use the as-built drawings for the deterioration model.	This survey will not be conducted.	Deflection survey will not be conducted by the team as the volume of heavy vehicle traffic is estimated to be low on the MCC-funded roads.
2	Pavement Structure/ Geotechnical	Santiago Roads	GPR survey of layer thicknesses, determination of adjusted structural number SNC, subgrade CBR and resilient moduli	This survey will not be conducted. The team will use information from as-built drawings and monthly and quarterly reports conducted by contractors and the supervisors.	This survey will not be conducted.	This survey will not be conducted. The team will use information from as-built drawings and monthly and quarterly reports conducted by contractors and the supervisors.	This survey will not be conducted.	Geotechnical survey is not required for the RED model. Therefore, the team will not collect this data for the evaluation.[27]
3	Road Condition – Surface Distress	Santiago Roads	Distress survey based on the LTPP Distress Identification Manual (June 2003) – LTPP distress identification and severity. Graphical illustration on the aerial imagery; Maintenance operation since road construction HDM-4 calibration	Review of the 2014 Road Network Condition Survey Data according to the HDM-4 distress classification	This survey will not be conducted.	Review of the 2014 Road Network Condition Survey Data according to the HDM-4 distress classification	This survey will not be conducted.	While RED does not require a detailed road condition data, the Road Condition Surface Distress data is available through secondary sources. The Evaluation Team will review the available documents and verify the data during roughness data collection.
4	Bridge Condition Survey	Santo Antão Bridges	Not stipulated as a requirement in Annex J	Condition of bridges classified as very good, good, fair, poor, or very poor.				IDG will use the information obtained during the first field visit instead of conducting an additional bridge condition survey.
5	Road Roughness Survey	Santiago Roads	Class 3 or better IRI measuring device (interval 150 – 300 mm, precision 0.2 – 0.5 mm). Sub sectioning at intervals of no more than 100m.	Roughness measurements collected using Bump Integrator or ARRB profilometer for each project road, reported every 100m.				Roughness data collection is continuous and changing the interval does not change the cost significantly. Also, roughness is a critical information for RED. The team will conduct the roughness survey and report every 100m.
6	Traffic Count	Santiago Roads Santo Antão Bridges	In accordance with FHWA's Traffic Monitoring Guide	Two rounds of manual traffic counts (February/August) for 6 days of 12-hours (0600-1800) and 1 day of 24-hours at the following 8 stations: • One approximately midway along the *Orgãos-Pedra Badejo Road* (Road 1) • One approximately midway along the *Cruz Grande-Calhetona Road* (Road 2) • One approximately midway along the *Assomada – Achada Grande* subsection (Road 4) • One at the entrance of *Porto Rincão* for the *Achada Grade – Porto Rincão* subsection (Road 4) • One on each of the four bridges in Santo Antão, for a total of four				Traffic count is an important data for RED and HDM-4. The team will conduct two rounds of manual traffic count to inform the models.
7	O-D Survey	Santiago Roads	Two consecutive market and non-market days at each site from 6am to 8pm. The stations should not be located near urban areas. A minimal interview sample rate of 20% of each vehicle type.	One round of O-D survey on two consecutive market and non-market days for 12-hours (0600-1800) during the dry season at the following 3 stations: • One approximately midway along the Orgãos-Pedra Badejo Road (Road 1) • One approximately midway along the *Cruz Grande-Calhetona Road* (Road 2) • One approximately midway along the *Assomada – Achada Grande* subsection (Road 4)				Based on the team's observations during the first field mission, the *Acahda Grande – Porto Rincão* sub-section has low traffic. O-D survey will be conducted at 3 stations only.
8	Public Transport User Survey	Santiago Roads Santo Antão Bridges	Not stipulated as a requirement in Annex J, but listed as an option in Technical Proposal	Conduct as part of the O-D survey with questionnaires issued to passengers on public transport vehicles intercepted.				The team will conduct the Public Transport User survey as part of the O-D survey to address Research Area 3 and 4.

9	VOC Survey	Santiago Roads	Vehicle operating costs/prices, fleet characteristics	HDM-4/RED Specialist will collaborate with a local staff member from the IE or from the ministry to conduct the VOC survey. This will help the ministry/IE conduct similar survey in the future. The following information will be collected during the survey: vehicle and tire costs/prices, annual utilization, fuel economic prices, maintenance labor, crew costs, and overheads.				The team believes that this is the most cost-effective way to conduct the survey as it will only require LOE from one or two staff members. Irvin Cohen has a strong track record in conducting road feasibility studies in numerous countries involving the collection of VOC data.
10	Road Inventory Data	Santiago Roads	Not stipulated as a requirement in Annex J	Road inventory data will be collected from secondary sources (design drawings and construction records). The team will review the documents available and analyze the road inventory data.	This survey will not be conducted.	Road inventory data will be collected from secondary sources (design drawings and construction records). The team will review the documents available and analyze the road inventory data.	This survey will not be conducted.	Detailed Road Inventory Data is not required for the RED model. Therefore, the team will not collect this data for the evaluation.
11	Axle-Load Survey	Santiago Roads	Axle load portable weigh pads	Include an O-D module collecting truck load characteristics. The Pavement Engineer and the Evaluation Team Leader will conduct spot observations to verify complement the O-D information.	This survey will not be conducted.	Include an O-D module collecting truck load characteristics. The Pavement Engineer and the Evaluation Team Leader will conduct spot observations to verify complement the O-D information.	This survey will not be conducted.	Truck traffic is particularly low and related pavement damage small, and axle-load information is not critical for the RED model. Therefore, the team will not collect axle-load data for the evaluation.
12	Maintenance Cost Survey	Santiago Roads Santo Antão Bridges	Funding available for maintenance and rehabilitation/reconstruction work over the last 10 years.	This data will be provided by GOCV (IE). The Team Leader and the Pavement Engineer will review the secondary sources in addition to conducting an additional visual inspection of the road during the IRI data collection.	This survey will not be conducted.	This data will be provided by GOCV (IE). The Team Leader and the Pavement Engineer will review the secondary sources in addition to conducting an additional visual inspection of the road during the IRI data collection.	This survey will not be conducted.	The data will be obtained mostly through secondary sources. The team will review the data and confirm its accuracy during the IRI data collection. While this is not critical for the RED model, this is a relatively cost-effective method to obtain the data to address research area 2.

Note 1: Boxes shaded in light green indicate the final data collection approaches selected by the Evaluation Team for data collection.

[27] During the in-country workshop conducted in Cabo Verde, the IE indicated that geotechnical survey, including coring and DCP at least every 2 km, would be highly desirable.

4.2.6 Road Condition - Surface Distress Survey

Description of Methodology and Instrumentation: A detailed condition survey of the main road network, including the MCC-funded roads, was performed in 2014 by IE, according to IE's distress catalogue. To ensure cost-effectiveness, the Evaluation Team will review and use the 2014 detailed condition survey data rather than conducting a full visual distress survey. The 2014 road condition data will be verified by field observations conducted by the Pavement Engineer to estimate the additional road deterioration from 2014 to 2018. Given that the roads are currently in good condition, it is expected that the major pavement distresses identified in 2014 will need to be revisited to estimate the increase in distress quantity and severity since 2014 and to establish correlation between IE Distress Catalogue and LTPP Distress Identification Manual (May 2014, Fifth Revised Edition).[28] The Evaluation Team will define distress conditions such as amount of narrow and wide structural and thermal cracking, raveling, potholes, edge break, and rutting for the MCC-funded roads. In addition, any areas of additional evident pavement deterioration will be noted.

Sample/Data Collection Location: Major pavement distress locations will be identified during the review of the 2014 IE condition survey.

Rounds and Timing: The team will review the major distresses identified in 2014 around October/November 2018 to overlap with the trip conducted by the Pavement Engineer to oversee the roughness survey.

Staffing: The field observations and data review will be conducted by the Pavement Engineer.

Safety Procedures: The Pavement Engineer will wear a high-visibility safety vest when conducting the visual inspections of the major pavement distress areas.

Quality Assurance/Quality Control: Condition survey results will be verified by visual observations made by the Pavement Engineer.

Analysis: The team will review and analyze both the 2014 IE condition survey and visual verification by the Pavement Engineer for the major distress areas and other field observations. In addition, all available records on major maintenance treatments performed since the road has been finalized will be collected from the IE.

4.2.7 Bridge Condition - Surface Distress Survey

Description of Methodology and Instrumentation: During the first field visit to the bridges, the team conducted a thorough review of the bridges and their surface condition. The Pavement Engineer and the Team Leader will review the data collected from the first field visit instead of undertaking a full visual inspection of the surface distress for the four bridges in Santo Antão. The Evaluation Team will define distress conditions such as amount of narrow and wide structural and thermal cracking, raveling, potholes, edge break, and rutting to classified bridge surface condition

[28] https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/ltpp/13092/13092.pdf

as very good, good, fair, poor, or very poor. In addition, any areas of additional evident pavement deterioration will be noted.

Sample/Data Collection Location: Major pavement distresses will be identified for the four MCC-funded bridges in Santo Antão.

Rounds and Timing: The team will review and verify the major distresses identified during the team's visit to Santo Antão for the manual traffic count.

Staffing: The data review will be conducted by the Pavement Engineer.

Quality Assurance/Quality Control: Condition survey results will be verified during the team's visit to Santo Antão.

Analysis: The team will review and analyze the information collected during the team's first visit to Santo Antão to identify major distress areas on the bridges. In addition, all available records on major maintenance treatments performed since the road has been finalized will be collected from the IE.

4.2.4 Road Roughness Surveys

Description of Methodology and Instrumentation: Roughness, in terms of the international roughness index (IRI, m/km) will be measured in the outer wheel path of each lane of the RBA roads using a Class 3 or better IRI measuring device per relevant ASTM standards and World Bank Technical Paper No 46 (Sayers, et al). While the Bump Integrator and the Roughometer (Australian Road Research Board, ARRB, Class 3 profiler) are methods that are often used in collecting this type of data, the team will use the ARRB Roughometer or equivalent, to avoid limiting the number of firms that could bid on the data collection.

At least six reference (or calibration) sections, 200-m long each, with different levels of roughness (covering at least the IRI range anticipated on the project roads) will be selected to provide appropriate precision and bias to the IRI measures of the three roads under the RBA. Each reference section will have its longitudinal profile measured in both wheel tracks using a topographical survey (dipstick or equivalent) method (Class 1). The reference sections will be used to establish a calibration equation (or calibration equations for different measuring speeds, as needed) for the Class 3 road roughness measuring device (e.g., ARRB laser profiler). Roughness measurements will be collected continuously along each project road, and will be reported for every 100-m section.

Following the roughness survey of the three project roads, the roughness measurement equipment will measure again the six reference sections and the IRI results will be compared with the results obtained during the calibration exercise. The six section-average roughness measurements (before and after) should not differ by more than five percent and any reference-section measure should not differ more than 10 percent. If the measurements differ beyond such limits, a new calibration should be performed, and the same process should be repeated until compliance.

Most of the roughness measuring equipment results depend on the dynamics of the vehicle where they are mounted. The dynamic properties are unique for each vehicle and change with time. Thus, the measures obtained from such equipment must be corrected to the IRI scale using a calibration equation that is obtained experimentally for that specific equipment, as described above. Because the dynamics of a vehicle change easily, very rigorous maintenance and operating procedures must be employed for the vehicles used, and control testing must be made a routine part of normal operations. When changes occur, there is no simple correction that can be applied; instead, the entire Roughometer-vehicle system must be recalibrated.[29]

The evaluation will utilize ASTM/World Bank standards or European standards. The standards will be decided following discussions with the selected data collection firm and MCC. The proposed standards are:

- ASTM E 950-09 Standard Practice for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling System
- ASTM E 1364-95 (12) Standard Practice for Measuring the Road Roughness by Static Level Method
- ASTM E 2133-03 (09) Standard Test using a Rolling Inclinometer to Measure Longitudinal and Transversal Profile of a Traveled Surface
- ASTM E1274-03 (12) Standard Test Method for Measuring Pavement Roughness Using a Profilograph
- ASTM E 1215-93 (12) Specification for Trailers Used for Measuring Vehicular Response to Road Roughness
- ASTM E1448/E1448M-09 (15) Standard Practice for Calibration of Systems Used for Measuring Vehicular Response to Pavement Roughness
- ASTM E1656/E1656M-11 Standard Guide for Classification of Automated Pavement Condition Survey Equipment.

Sample/Data Collection Location: Roughness is measured continuously on the two outer wheel paths of the project roads and will be reported at intervals of 100 meters.

Rounds and Timing: Roughness measurement will be conducted in November/December 2018.

Staffing: It is estimated that a staff of two will be appropriate: one driver and one technician-operator. The Pavement Engineer will oversee the overall data collection efforts.

Safety Procedures: The measurements need to be taken at a constant speed. As a result, the driver and operator will have to plan to use adequate speeds depending on the local conditions considering urban/community crossings.

Quality Assurance/Quality Control: The Evaluation Team will review the calibration exercise and assure that the survey firm considers the equipment manufacturer recommendations, as well as those mentioned in the World Bank Technical Paper No 46, when carrying out the measures, analysis and reporting of results.

[29] World Bank. 1986. Guidelines for Conducting and Calibrating Road Roughness Measurements. WB Technical Paper No. 46 (by Sayers et al.). http://documents.worldbank.org/curated/en/851131468160775725/pdf/multi-page.pdf

Analysis: The Evaluation Team will graphically illustrate the IRI for the entire chainage (kilometers on x-axis, IRI on y-axis, with data values for each 100-m road section). The Pavement Engineer will then divide the road segments into homogenous or dynamic sub-sections, which will also be graphically illustrated.

4.2.5 Manual Traffic Counts (MTC)

Description of Methodology and Instrumentation: The conventional approach to traffic counting on roads and bridges that carry relatively light traffic, generally less than 1,000 vpd is to use the manual paper-based method.[30] The manual counting method has the advantage of recording as many varieties of motorized vehicle as required by a particular study. These counts are referred to as MTC and they are usually performed in 15-minute intervals for each direction of flow. One A4 or letter sheet of paper has four 15-minute intervals such that each sheet represents one hour of vehicle movements. Vehicles are recorded in batches of five using the '5-bar gate' configuration as follows:

A sample MTC paper sheet is presented in Annex I.

Sample/Data Collection Location:

Roads

The exact locations for traffic counting will be decided in discussion with MCC. The Evaluation Team suggests that the traffic counts be conducted along each of the three project roads as follows:

Road	Location
Road 1, Orgãos – Pedra Badejo	approximately midway along this section
Road 2, Cruz Grande – Calhetona:	approximately midway along this section
Road 4, Assomada – Porto Rincão[31]: *4a, Assomada – Achada Grande*	approximately midway along this sub-section
Road 4, Assomada – Porto Rincão: *4b, Achada Grande – Porto Rincão*	at entrance to Porto Rincão

Please see Annex III for illustrative maps that depict the approximate locations of the counting stations on the three roads. While an approximate mid-way position along the road section would be preferred, consideration must also be given to the availability of some basic facilities such as a café or small shop or filling station to ensure the safety and basic comfort of the traffic counters.

Bridges

[30] Whereas automatic traffic counting procedures, using piezo or similar sensors which are embedded in the pavement, are able to record high traffic volumes on a continuous basis that often are permanent, their limitation is the inability to distinguish between numerous vehicle types other than broad categories that are related to the length of each vehicle and the longitudinal spacing of axles.

[31] This section of road comprises two distinct sub-sections in terms of roadside development and land use. For the first half of the road, approximately 7.5 km from Assomada, there are numerous dwellings and small-scale shops whereas the second half of the road, from the point where there is an uphill cobblestone pavement of some 900 metres that levels out to a plateau, all the way to Rincão, the land is barren with a complete absence of population and agricultural activity. For this reason, two separate counts are to be conducted for each sub-section.

The Evaluation Team suggests that the traffic counts be conducted along each of the four project bridges as follows:

Bridge	Counting Station Location
Bridge on access road to Eito	One station on the bridge (on one of the sidewalks)
Road Paul – Ribeira Grande	One station on the bridge (on one of the sidewalks)
Ribeira Grande	One station on the bridge (on one of the sidewalks)
Ribeira da Torre	One station on the bridge (on one of the sidewalks)

Rounds and Timing: Two rounds of traffic count surveys will be conducted at two separate times of year to account for seasonal adjustments. Seasonal traffic count data is currently unavailable from the IE. In order to estimate the seasons when the traffic is high or low, the team examined the monthly number of incoming tourists between 2015 – 2017, which showed no clear pattern.[32] Based on the monthly fuel retail sale (2014 – 2017) provided by the Economic Regulation Agency (ARE), the team observed little monthly variations but was able to identify February and August as potential months with the lowest and the highest traffic.[33] Therefore, the team will undertake the traffic counts in August and February to observe the seasonal variations in traffic.

The previous traffic counts that were undertaken in 2005 and 2010 under the first Compact were done for a 16-hour period, 06h00 – 22h00 for seven consecutive days (Monday through Sunday). The Evaluation Team will conduct a 12-hour traffic counting period with one 24-hour count. The Evaluation Team proposes to conduct one of the traffic count surveys in conjunction with the O-D survey, however, this will depend on the capabilities of local subcontracts to conduct the two surveys at the same time. IDG will ask subcontractors to provide cost information on conducting the surveys both at different times and concurrently. The best course of action will be decided based on the cost information received.

Staffing: The Evaluation Team intents to subcontract the traffic count surveys. In this case, team sizes will be determined by the successful bidder based on a competitive procurement process. For inter-urban traffic surveys with traffic volumes less than around 1,000 vpd, manual counts are typically performed by a team of two persons for each direction of traffic. In addition, one supervisor is to oversee both the MTC and O-D surveys on each road (if/when O-D and MTC surveys are conducted concurrently). Due to the proximity of the bridges, a supervisor can serve two traffic count stations at once, therefore only two supervisors are needed in total.

Safety Procedures: Approximately, two to three meters of space is required inward from the carriageway in order to position tables and chairs and also umbrellas for the enumerators or a tent-like structure that will provide protection against the sun and rain. Positioning of the survey location would also need to ensure good visibility in both directions (i.e. road bends or slopes must be avoided). For the surveying that takes place in the dark, portable battery powered lamps with

[32] According to a report by the Netherlands Enterprise Agency, "The distribution of tourist is concentrated (91% of tourists) in two islands, Boa Vista with 41% and Sal with 50% of night stays. Spontaneous and small-scale marketing initiatives leads Cabo Verde Private Sector Development: Multi-Sector Market Study focused on Tourism Value Chain Development 10 the rest of 9% of the market of tourist night stay to Santiago (4%), São Vicente (3%) and the four other Islands with only 2% of guests in 2016." It is estimated that the number of tourists affecting the traffic in Santiago and Santo Antao is limited; Netherlands Enterprise Agency, Cabo Verde: Multi-sector market study focused on tourism value chain development, June 2017.

[33] Data from the Economic Regulation Agency (ARE) of monthly fuel sale from 2014 to 2017.

suitable back-up batteries, will be needed to give light to the counters. The surveyors will also be provided with yellow reflective jackets.

Quality Assurance/Quality Control: The Evaluation Team will conduct random checks to ensure the data is recorded correctly and quickly rectify any anomalies. The role of the supervisor is vital in order to consistently check the work of the counters to ensure the vehicle types are properly categorized in the appropriate columns on the traffic count form. Traffic count stations will have a minimum of two personnel at all times and reserves will be in place in case of unexpected emergencies. Data entry from the paper forms into Excel will also be monitored and randomly checked.

Analysis: The MTC paper sheets will be checked by the supervisor during the course of the day with a focus on the hourly totals for each vehicle class. At the end of each day, the sheets will be taken by the supervisor and the data transferred into an Excel spreadsheet for each counting station. Excel will be used to process the data in the following sequence:

i) Formulate the count data by direction, by hour, and by vehicle class for each day of the week;
ii) Formulate survey duration by 12-hour totals by direction and by vehicle class for each day of the week;
iii) Formulate 24-hour totals by direction and by vehicle class for each day of the week (by utilizing the 24-hour data to derive the 12:24-hour factors) and calculate the seven-day average; and
iv) Formulate bi-directional (two way) traffic flows by vehicle class.

The average daily traffic (ADT) data will be calculated into annual average daily traffic (AADT) by referencing data on monthly fuel consumption figures for 2017 supplied by the ARE. It is also important to note that meaningful comparisons with the traffic counts in 2005 and 2010 may not be possible because the previous counts were performed within built up areas such that particularly high volumes were observed which would to be made.[34]

4.2.6 Origin-Destination Survey (O-D)

Description of Methodology and Instrumentation: The O-D survey methodology will consist of intercepting vehicles at one location on each of the three project roads, administering a short questionnaire to the vehicle occupants, and recording information on the type of vehicle and on the occupants (including number of occupants and gender.) While O-D surveys are not going to be conducted on the MCC-funded bridges, supplementary questions are going to be added to the O-D surveys conducted on the roads to obtain information on the purpose of trips done by the those who use the bridges.

The questionnaire could be administered in several different ways. An interviewer/enumerator could conduct the survey in-person by soliciting responses verbally or by issuing a paper form which the occupants would fill out. Another option would be to provide each occupant with a token

[34] It is to be noted that the traffic count Excel analyses performed in 2005 and 2010, as per the folders supplied to IDG (*Contagem de Trafego 2005_Banco Mundial* and *Contagem de Trafego_2010_MCA*) incorrectly averaged the two uni-directional flows meaning that reported daily traffic was in fact halved. This in turn implies that volumes were of a considerable magnitude.

that would allow them to complete the survey later via phone or internet; an advantage of this option is that it would allow incentives - such as electronic gift cards or free cell phone air time minutes – to be used to increase survey participation and the response rate. Incentives can sometimes lead to respondent bias; however, in this case where the respondents would primarily be reporting factual information (e.g., the starting/endpoint locations of the journey and the fare, in contrast to perceptions, level of satisfaction, etc), such bias would likely be limited. As noted below, the survey will be administered by a subcontractor who is selected based upon the rationale and cost of their proposed survey approach. Any approach will need to maximize the response rate while taking into account issues such as the literacy rate, internet access, and cell phone usage.

The following type of questions will be asked to the drivers: trip origin, trip destination, trip purpose, trip distance, vehicle type and axle configuration, capacity and volume of load, occupancy (including number of occupants and gender), and type of commodity carried (if goods vehicle). In addition to the standard questions, the O-D questionnaire will collect additional elements including fares for goods and people. By asking about gender and purpose of trip (work/non-work), the team will be able to analyze short-term impacts disaggregated by gender by comparing the share of road usage by gender and conduct additional analyses with respect to the purpose of usage by gender, including whether that usage is income-generating and what types of goods, if any, are transported by women.[35][36]

Additional questions will be included in the O-D survey to address Research Question 2B. The questionnaire will ask if the drivers have used the road before and whether the road improvements led to any benefits including time savings, reduction in fare, and the frequency of trips taken on MCC roads. Below table indicates the illustrative type of questions that will be asked during the O-D survey depending on the type of drivers:

Type of questions asked	**Type of Drivers**		
	Private car owners	Freight/cargo transporter/ forwarders	Public/private transport drivers
Trip origin	X	X	X
Final trip destination	X	X	X
Vehicle type/axle configuration	X	X	X
Seating capacity of vehicle	X		X
Maximum load (tons)		X	
Current load (tons)		X	
Type of goods carrying (according to classes)		X	
Estimated value of the goods carrying		X	
Average speed when traveling on road section	X	X	X

[35] For example, as was found in a study in Armenia, while male heads of households were more likely than female heads of household to report using the road for access to market, female heads of household were more likely to report other uses: women reported using the road about one day a month to visit relatives, go shopping and for other activities that were not income-generating. *Evaluation of a Rural Road Rehabilitation Project in Armenia.* March 12, 2015. Mathematica Policy Research. Submitted to Millennium Challenge Corporation.

[36] For example, as found in Ethiopia, women used the road to transport agricultural produce. Bryceson, D. F., Bradbury, A., & Bradbury, T. (2008). Roads to poverty reduction? Exploring rural roads' impact on mobility in Africa and Asia. *Development Policy Review*, *26*(4), 459-482.

Type of questions asked	Type of Drivers		
	Private car owners	Freight/cargo transporter/ forwarders	Public/private transport drivers
Estimated traveling time from origin to destination	X	X	X
Purpose of trip	X		
Distance of trip	X	X	X
Number of passengers (by gender)	X		X
Frequency of trips on the road per month/year	X	X	X
Question to be asked to drivers and preferably all occupants of cars: Did you travel on road before improvement, before 2005?	X	X	X
If yes, for the same destination, how much time was required to travel on the road section in the past?	X	X	X
Since the improvement, are you making more trips on the road than before the improvement?	X	X	X
Are the types of trips after the improvements different than before? If yes, explain.	X		

Sample/Data Collection Location: Whereas sample sizes vary according to traffic volume, a 20 percent sample (every fifth vehicle) is often used as a suitable benchmark. However, where traffic volumes are low, the sample size can be increased to around 33 percent (every third vehicle). At the same time, the surveyors must be aware of the need to sample all vehicle classes, so it can be expected that trucks will have a higher sampling rate given their relatively low number.

The Evaluation Team suggests that the O-D surveys be conducted along each of the three project roads as follows:

Road	Location
Road 1, Orgãos – Pedra Badejo	approximately midway along this section
Road 2, Cruz Grande – Calhetona:	approximately midway along this section
Road 4, Assomada – Porto Rincão: *4a, Assomada – Achada Grande:*	approximately midway along this sub-section

While an approximate mid-way position along the road section would be preferred, consideration will also be given to the availability of some basic facilities such as a café or small shop or filling station to ensure the safety and basic comfort of the surveyors while making sure there is sufficient space to safely stop vehicles in a cordoned off area of the road.

Rounds and Timing: The O-D surveys will be conducted at three road sections: *Orgãos– Pedra Badejo* (Road #1), *Cruz Grande – Calhetona* (Road #2), and Assomada – Achada Grande (Road #4 subsection 4a) for two consecutive market and non-market days at each site from 6am to 6pm.[37] The surveys will be implemented once. The time of the survey will be discussed with MCC, IE, and the selected subcontractor. When selecting the most appropriate time to conduct the survey, the team will take into account several factors including the possibility of conducting the O-D surveys concomitantly with the second round of traffic count surveys, and selecting a time of the

[37] Wednesday is the main market day for Assomada.

year that will help capture the seasonality of tourism to assess whether tourists spend more time in the areas served by the roads.

Staffing: The O-D surveys will be contracted to a subcontractor. In this case, team sizes will be determined by the successful bidder. O-D surveys are usually performed by a team of between two and four persons for each direction of traffic.[38] In addition, one supervisor is to oversee both the traffic count and O-D surveys on each road (if the O-D survey is conducted in conjunction with one of the MTC rounds).

Safety Procedures: Safety procedures will be coordinated with the local traffic police. All personnel will be required to wear high-visibility safety vests at any time. The IDG team will develop traffic control plans to ensure all personnel are safe at each survey station. The traffic plans will provide guidance on the position of the traffic delineators and the percentage of road that needs to be cordoned off with traffic cones to allow for sufficient space to stop and park the vehicle while the surveyors are working. The traffic plans will include sketches that provide a visual representation of the survey work area and the space needed to be cordoned off. The police, supported by appropriate signage, will help stop and direct the surveyed vehicle to the secured survey work area. In addition, approximately, two to three meters of space is required inward from the carriageway in order to position tables and chairs and also umbrellas or a tent-like structure that will provide protection against the sun and rain where surveyors can stow survey materials or rest during periods of no survey activity. If the O-D survey is conducted in conjunction with one of the MTC rounds this will represent the station where the enumerators are standing to observe and count the traffic. Positioning of the survey location would also need to ensure good visibility in both directions (i.e. road bends or slopes must be avoided).

Quality Assurance/Quality Control: The Evaluation Team will conduct random checks to ensure the data is recorded correctly and quickly rectify for any anomalies. The role of the Supervisor is vital in order to consistently check the work of the surveyors to ensure the surveys are conducted properly. The Supervisor will closely oversee the O-D surveys to ensure that information is complete, and data are not missing.

Analysis: The information on the O-D paper sheets will be transcribed into Excel formatted worksheets. Some of these data will subsequently be input into the RED model and, where necessary, analyses will be required to obtain averages for vehicle occupancy and for determining the percentage of work related trips. Other information will be used to validate and provide context for the ERR estimates, as well as provide support for Research Area 4. For example, the O-D data could potentially be used to identify profit/loss margins (which could be an indicator of market competitiveness), assess whether different operators are charging the same fares for given O-Ds, and determine whether discounts are provided for certain classes of travelers (for example, regular/long-time customers, elderly, women or women with children etc.)

4.2.7 Public User Transport Survey

Description of Methodology and Instrumentation: This survey will be conducted as an extension of the O-D survey to collect more detailed information regarding individual journeys

[38] A work schedule of 1.5 hours followed by a 0.5-hour rest time for each interviewer may be configured.

including information on fares, discounts, travel times, and preference for specific drivers. The team will use short forms on paper or tablets (instead of administering questions verbally by an interviewer) to the passengers of intercepted public transport vehicles to mitigate the possibility that passengers may be reluctant to provide information that can be overheard by other passengers. For example, passengers who receive a discount on their fare may not want other passengers to know that, out of fear that they may lose the discount if other passengers start demanding it.

An alternative would be also to allow respondents to complete the survey at a later time by providing them with self-addressed stamped envelopes, post cards with the web address to an online version of the survey, or tokens that would allow them to complete the survey via phone. An advantage of some of these options is that they would allow incentives - such as electronic gift cards or free cell phone air time minutes – to be used to increase survey participation and the response rate. Incentives can sometimes lead to respondent bias; however, in this case where the respondents would primarily be reporting factual information (e.g., the starting/endpoint locations of the journey and the fare), such bias would likely be limited. As noted below, the survey will be administered by a subcontractor who is selected based upon the rationale and cost of their proposed survey approach. Any approach will need to maximize the response rate while taking into account issues such as the literacy rate, internet access, and cell phone usage.

Sample/Data Collection Location: Since the public user transport survey is an extension to the O-D survey, the instrument will utilize the same sampling method and data collection location.

Rounds and Timing: The surveys will be issued during the same days as the O-D surveys.

Staffing: The teams conducting the O-D survey will conduct the public user transport survey as an extension of the O-D survey, therefore no additional staff is needed. The O-D survey team will either hand out the survey or will help the respondent complete the form on the tablet.

Safety Procedures: The safety procedures will adhere to the same protocol used for the O-D survey.

Quality Assurance/Quality Control: The Evaluation Team will conduct random checks to ensure the data recorded is correct and for any anomalies that may be noted so that they can be quickly rectified. The role of the Supervisor is vital in order to consistently check the work of the surveyors to ensure the surveys are conducted properly.

Analysis: The information obtained will be transcribed into Excel formatted worksheets. Some of these data will be used to obtain averages and provide context for the RED model to estimate the ERR, as well as provide support for Research Area 4. For example, the data could potentially be used to identify profit/loss margins (which could be an indicator of market competitiveness), assess whether different operators are charging the same fares for given O-D, and determine whether discounts are provided for certain classes of travelers (for example, regular/long-time customers, elderly, women or women with children etc.)

4.2.8 VOC/Vehicle Fleet Data Surveys

Description of Methodology and Instrumentation: VOC information constitutes one of the primary inputs required by the RED model. Cost and price data will be obtained from the main dealerships in Praia with respect to vehicles and tires. Various other information relating to vehicle operation and maintenance will be obtained from garage/servicing companies, bus and road haulage operators, taxi and minibus operators, insurance companies as well as the General Directorate of Transport and Roads. Representative types of vehicle for each vehicle class will be identified following discussions with these various actors and agencies. Vehicle fleet registration, vehicle licensing data, and vehicle imports data will help cross-check whether the representative vehicle types identified during interviews are accurate. It is important to identify the representative types of vehicles as it influences the types of stakeholders that need to be interviewed. For example, the Toyota Hiace is the representative vehicle for minibuses (*Yasi*) and accordingly the main Toyota dealership would need to be interviewed to obtain relevant cost information. Similarly, the most commonly used or typical model for each of the other vehicle classes need to be identified and the relevant cost data obtained for that particular model.

Rounds and Timing: VOC data collection will take place during Option Period 1. Data will be obtained by means of personal interviews and direct discussions with each of the various companies, organizations, and entities. The retail vehicle and tire price information must include the price breakdown showing all taxes and import duties. Garages will be surveyed for information on hourly labor costs for the servicing of the different vehicle classes. Bus and truck haulage companies will be interviewed for information on driver and crew wage rates and also for information on average annual kilometrage traveled in the previous year as well as the average number of working annual working hours that the vehicles have been in operation in the previous year. The annual kilometrage and working hours are required for the other vehicle classes through random sampling of work colleagues, business associates, garages, and friends. Insurance companies will also be interviewed for information on premiums for each vehicle class.

Staffing: The survey will be conducted by the HDM-4/RED Specialist, who has vast experience conducting VOC surveys in multiple countries across Sub-Saharan Africa. The team will include a local staff member from IE or from MIOTH to shadow and support the HDM-4/RED Specialist in conducting the survey. This will allow the ministry/IE to conduct the survey in the future.

Quality Assurance/Quality Control: Data provided by the commercial dealerships on prices of vehicles and tires should be on official notepaper and/or from their published brochures with dates of quotes given. Data on annual utilization are only subjective based on the experience of users and from any other studies. For costs of maintenance labor (vehicle servicing), as many servicing dealers as possible should be surveyed in order to obtain an overall average for each vehicle class.

Analysis: For each of the representative vehicle types, the relevant RED input data will be formulated in a preparatory Excel file. An indicative sample is illustrated in Annex II. Certain inputs will require some analysis such as the derivation of the economic price of fuel and the calculation of travel time values. In the case of the former, this analysis will utilize the fuel price structure information from ARE and in the case of the latter, travel time values will be determined with reference to wage rate information by employment sector and/or GDP per capita data.

4.2.9 Maintenance Cost Surveys

Description of Methodology and Instrumentation: The Evaluation Team will perform KIIs with main stakeholders, IE and major road maintenance contractors that have submitted bids for performance-based contracts (called REMADOR[39]) and/ or have implemented REMADOR contracts on the island of Santiago. The Evaluation Team will review available data of maintenance cost provided by IE and *Fundo de Manutenção Rodoviária* (FAMR). The review will include unit cost per km of REMADOR contracts for asphalt and cobblestone roads on the island of Santiago, as well as unit costs of individual work items, as submitted by contractors.

The data collection and analysis will be led by the Team Leader and the Pavement Engineer. The historical trends of cost of major pavement maintenance treatments will be analyzed to define cost that should be used for modeling in RED analysis.

4.2.10 Analysis Plan

RED Analysis

The HDM-4 is the tool developed by the World Bank to compare and rank projects. Although HDM-4 is the most widely applied framework for the economic analysis of road investments, it requires inputs which may be impractical to collect for vast networks with low traffic levels, such as surface layer materials' properties and refined traffic data.[40]

A simplified version of this product, appropriate for present conditions for the MCC-funded roads in Cabo Verde, is the World Bank's RED model, which is a much simpler tool to use than HDM-4. While the HDM-4 model is a proprietary commercial software, the RED model is a free software (Excel spreadsheets) available to the public. The RED model's algorithms are identical to that of the HDM-4 model for estimating vehicle operating costs. However, the RED model assumes constant life-cycle roughness values in the "with" and "without" project scenarios. RED model also requires the team to use engineering judgement to determine likely maintenance costs for both the "with" and "without" project options. such, the model is already structured and only requires data input according to the format preset in the software. The input data must satisfy the model requirements related to types of units and dimensions and data ranges.

Using the RED model, the HDM-4/RED Specialist will assess and compare the costs and economic benefits of MCC's road rehabilitation. The costs will be based on the discounted whole life costs (rehabilitation and subsequent maintenance for the effective life of the road), and the benefits are the savings to be made in reduced vehicle operating costs, shorter journey time.

Bridge Economic Analysis

The bridge analysis is entirely separate from RED model, which is applicable only to road sections and road networks. The bridge economic analysis is premised on benefits deriving from time that would otherwise have been lost due to road impassibility through extreme weather events and destroyed bridge infrastructure. In the first MCC Compact, a figure of eight days was used as the period in one calendar year in which road access was impassible between the towns of Paul and

[39] REMADOR: Reabilitacao e Manutencao com Base no Desempenho e por Obrigacao de Resultados (Rehabilitation and Maintenance Based on Performance and Results Accomplished).

40 The Roads Economic Decision Model (RED) for the Economic Evaluation of Low Volume Roads. Software User Guide & Case Studies.

Ribeira Grande on Santo Antão. Before construction of the new bridges in each of these two towns, traffic would use a portion of the respective riverbeds. In the municipality of Paul, the absence of the two bridges meant that part of Vila das Pombas town itself and the access route to the neighboring area of Eito were cut off from the rest of the island when these riverbeds were flooded or blocked by rock and boulder debris. In the case of Ribeira Grande, the absence of the two bridges also meant that part of the town was cut off. In addition, the main portion of Vila das Pombas[41] and Ribeira Grande (approximately 23 km), which included the settlement of Sinagogue, could not be access due to excessive flooding.

In line with the analysis performed in the first MCC Compact, the updated estimation of benefits will be based on lost revenues in terms of work related trips, average daily incomes and average daily traffic.[42] In addition to these variables, consideration will also be given to estimated economic losses with respect to pedestrian injuries and even some fatalities that were previously recorded during the severe weather occurrences.[43]

For the economic analysis, the team will utilize secondary data available from IE as well as primary data collected as part of the manual traffic counts, O-D surveys, and visual observations of the condition of the bridges conducted by the IDG team during the first mission (December 2017).

Graphic Presentation of Main RED Data Inputs
The Evaluation Team proposes to use the shape files received for the three MCC roads in lieu of collecting aerial photography images to graphically present the data collected for the evaluation.

4.3 CHALLENGES

4.3.1 Limitations of Interpretation of the Results or Risks to the Study Design

While both the RED and HDM-4 models do use the same vehicle operating cost relationships, there are indeed differences in output results given that the former is a static application in which a subjective assessment is made for pavement deterioration over time purely in terms of road roughness (IRI) whereas the latter is a sophisticated dynamic application that analyses a wide number of variables in assessing pavement deterioration over time.

The second risk item is that the present tools used in this evaluation will be a one-time event and the GOCV might not use the tools in the future. This risk will prevail irrespective of whatever software or evaluation tool is used whether now or in the future. There will always be an inherent risk given the vagaries of qualified staff in the public sector, government remuneration levels vis a vis the private sector, and high turnover caused by well qualified personnel potentially emigrating overseas. This risk can be mitigated by involving IE staff in the evaluation process, including in the data collection and analysis, and carrying out workshops at IE on the technical procedures being applied during the evaluation.

[41] Including the municipal cemetery
[42] World Bank Project Appraisal Document, Road Sector Support Project, April 22, 2005 (page 75).
[43] Discussions with local residents and minibus (Yasi) drivers during the field visit of 8 and 9 December 2017.

V. EVALUATION DESIGN – RESEARCH AREA 2: MAINTENANCE

5.1 LITERATURE REVIEW

The quality of a country's roads correlates strongly with the quality of its institutions. According to the World Economic Forum's Global Competitiveness Index, road quality and overall institutional quality in CV have a correlation of 0.80.[44] CV is very well governed compared to other countries in sub-Saharan Africa (SSA). CV scores well above average in a wide range of governance indicators, such as control of corruption, government effectiveness, regulatory quality, and rule of law. The country rates similarly well across a range of the World Bank's Country Policy and Institutional Assessment (CPIA) scores, with the exception of Quality of Budgetary and Financial Management, where it rates slightly below the average for SSA (see figures 5.1 and 5.2 below[45]).

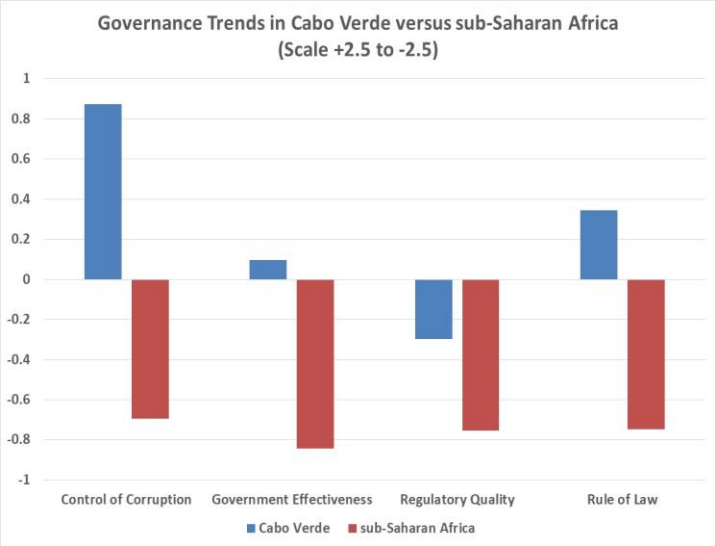


Figure 5.1 Governance Trends

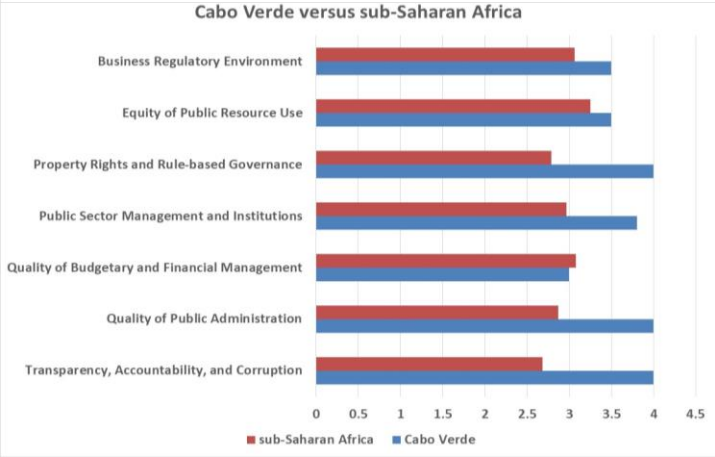


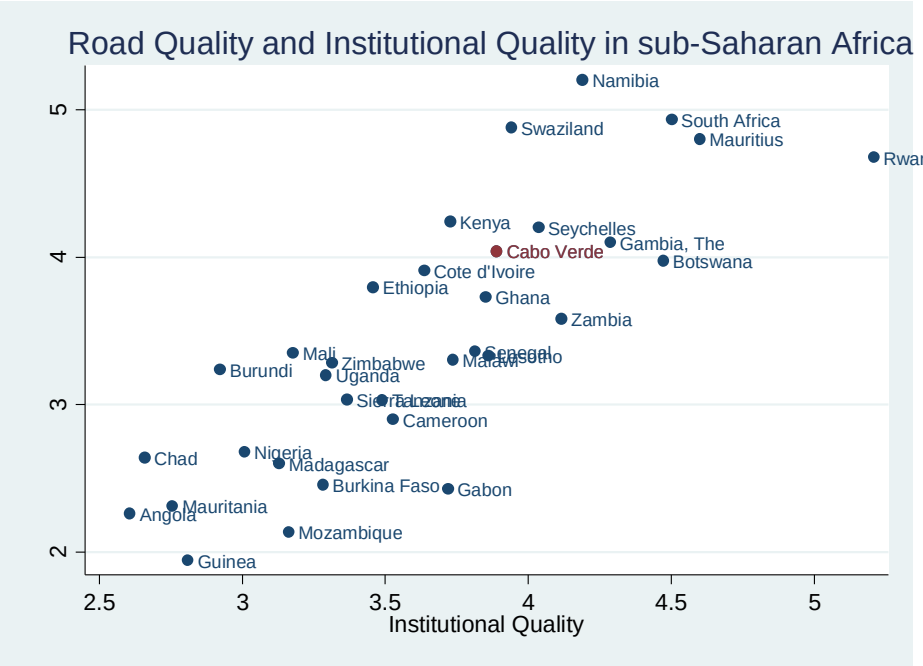
Figure 5.2 CPIA scores

[44] Data available at: http://reports.weforum.org/global-competitiveness-index-2017-2018/#topic=data

[45] Chart Data Sources: First Chart – Worldwide Governance Indicators; Second Chart – World Development Indicators.

Cabo Verde rates similarly well in the quality of its roads. As Figure 5.3 below shows[46], only a small number of countries in SSA have higher quality roads than Cabo Verde according to the World Economic Forum's Global Competitiveness Index. Unsurprisingly, these are also among the best governed countries in the region, such as Mauritius, Rwanda, and South Africa.

Figure 5.3: Road Quality and Institutional Quality in Sub-Saharan Africa



The Transport Sector Strategy 2008-2020 spells out the GOCV's vision for the development of the road sector. The objectives include completing the rehabilitation of the core road network as well as strengthening the institutional capacity for planning, execution, and management of road infrastructure. The government has achieved significant progress in advancing institutional reforms in the road sector over the past few years, including creating a functional road fund (FAMR), establishing a road agency (IE), and improving planning capacity. The GOCV has also introduced performance-based maintenance contracts called REMADOR.[47]

This progress notwithstanding, the GOCV continues to encounter challenges in securing an adequate road network. The main shortcomings are ensuring sufficient funding for maintenance and emergency repairs, scaling up REMADOR, constructing climate-resilient roads, and undertaking adequate rehabilitation and timely emergency repairs. Securing adequate funds for road maintenance is likely to be challenging in the near term as the GOCV is entering a period of fiscal austerity to reduce the country's high level of debt.[48] Addressing the aforementioned issues poses significant political economy challenges as well.

Designing a cost-efficient road network in Cabo Verde is a challenge due to its low population density spread across nine islands and policies that prioritize expanding the network to areas with

[46] Source of data for graph: World Economic Forum's Global Competitiveness Index
[47] World Bank. 2013. Republic of Cape Verde Transport Sector Reform Project. Washington, DC: The World Bank.
[48] IMF. 2016. Cabo Verde: Staff Report for the 2016 Article IV Consultation. Washington, DC: The World Bank.

small populations.[49] The rational design of a road network is to prioritize roads according to their ERR. As a result, priority roads are those that connect to centers of populations, those that develop new areas of economic activity (e.g., tourist areas), or those that help access international markets (e.g., road to a port). By contrast, connecting a new community to a feeder road or replacing an earth or gravel one with a tarmac road has enormous beneficial consequences for hitherto isolated communities, but low aggregate economic returns and pushes up future maintenance costs.

Road maintenance is also susceptible to corruption. One potential area of corruption is in procurement and contract awards. While the optimal method is some type of merit-based competitive award, bribery from potential awardees and/or government officials steering road contracts to favored firms is common.[50] Corruption is also possible in road maintenance tenders because unit costs are often difficult to determine and overseeing road construction is challenging. Unless the officials making the awards are well aware of the optimal costs given the technical requirements, asymmetric information may cause even an honest civil servant to make an award to a corrupt firm. Since it is very costly to supervise road construction, contractors also have the capacity to benefit from road contracts by using substandard materials and/or not using the right amount of materials. Roads that are too narrow or shallow, for example, are common in Cabo Verde. The GOCV has experimented with performance-based maintenance contracts (PBMC), which specify outcomes, not inputs, to reduce these types of risks. The key challenge is maintaining PBMC with adequate supervision.

Road maintenance also suffers from insufficient funding in Cabo Verde. Since many governments will try to satisfy the demands of a range of stakeholders, funds for road maintenance compete with many other priorities. If government officials and elected politicians fail to demand adequate funds for road maintenance, they are unlikely to be appropriated to a sufficient level. This has been occurring in Cabo Verde and there is a large backlog of routine maintenance and emergency works. The GOCV has attempted to ensure sufficient funds for road maintenance through creating a dedicated road fund, FAMR, paid through a fuel levy. However, the fund only raises about $6 million per year. Even if all funds collected through FAMR were allocated to maintenance, it would only cover about half of the needed budget to maintain the network in good working condition. In 2013, the World Bank estimated the Cabo Verde will need to spend about $200 million between 2010 and 2030 "to cover all needs in terms of rehabilitation, routine and periodic maintenance and emergency works."[51]

The World Bank has been a key development partner for road sector development and reform in Cabo Verde. Its Transport Sector Reform Project (TSRP) is $58 million from 2013-2020 ($31 million for 2013-2019 and $27 million extension to 2020). The 2013-2019 World Bank project focuses on road preservation (rehabilitation and maintenance), institutional strengthening, road safety, and inter-island transport. The 2019-2020 extension will cover road

[49] World Bank. 2013. Republic of Cape Verde Transport Sector Reform Project. Washington, DC: The World Bank.
[50] Klopp, Jacqueline. 2011. "Towards a Political Economy of Transportation Policy and Practice in Nairobi." Urban Forum.
[51] World Bank. 2013. *Republic of Cape Verde Transport Sector Reform Project.* Washington, DC: The World Bank. Page 8.

maintenance, emergency works, road safety, and institutional reform. The GOCV provided $12 million in counterpart funding for the project.[52]

5.2 EVALUATION QUESTIONS

The purpose of the Research Area 2 questions is to understand the current road maintenance practices conducted on the Cabo Verde national road network and to define a set of maintenance assumptions.

A) What are the relevant road authority's current maintenance practices and what is the likelihood that MCC's investment will remain adequately maintained for the life of the investment? Based on this assessment, what set of maintenance assumptions should be used in the HDM-4 model to yield the best estimate of the costs and benefits of the road investment? [Core]

1. What are the procedures for awarding contracts for road maintenance activities? Are bids open and assessments transparent? How do actual processes differ from official ones?
2. What are the procedures for selecting roads sections that are candidates for maintenance works? How is decided what maintenance works are needed? What criteria are used for selection?
3. What maintenance works are included in the REMADOR performance-based contracts in addition to road cleaning?
4. What are the procedures to define candidate sections for periodic maintenance/rehabilitation? What are the typical pavement periodic maintenance treatments for asphalt roads and when are they performed? What is the expected period between two periodic maintenance treatments? What is the cost of these treatments?
5. What level of IRI can be achieved after periodic maintenance/rehabilitation?
6. How supervision of maintenance works (e.g. REMADOR) is performed?

Prior to the Compact RBA, as assessed by the World Bank completion report of the Road Sector Support Project (RSSP),[53] due to inadequate maintenance, certain sections of the road network in each island had deteriorated, while in other cases lack of investment had left the basic network incomplete, constituting a serious constraint to development for Cabo Verde. The report mentioned that the dedicated road management agency was absent, there were no systematic programs for maintenance, and that there was not a clear division between different GOCV agencies regarding the management of road networks. Maintenance and investment in the road sub-sector was managed by the General Directorate of Infrastructures and Basic Sanitation in the Ministry of Infrastructure and Transport.

Under the Compact RBA, MCC supported a portion of the RSSP, by providing parallel financing to fund road works in the island of Santiago and bridges in Santo Antão. The IDA/World Bank project design, and consequently the Compact RBA, adopted several relevant lessons learned from

[52] Ibid

[53] World Bank. 2014. CV Road Sector Support Project (IDA-40640): Implementation Completion and Results Report (No. ICR2763, dated May 28, 2014).

similar projects in Cabo Verde and across SSA. First, considering only the traditional ERR calculation when deciding whether to invest in a road that helps secure minimum access to isolated communities is not sufficient when the goal is to support economic development and poverty reduction activities as these types of projects usually render low ERRs. Second, viable maintenance management and sustainable finance arrangements need to be in place to secure any new infrastructure project to ensure sustainability as past experience in Cabo Verde had shown that without a dedicated road agency, the necessary management and investment services needed to support development could not be achieved.

While IDA/World Bank took the leading role in the institutional aspects, particularly road management, as a result of the joint support of IDA, MCC and other donors, there have been substantial achievements in the Cabo Verde road sector, particularly regarding road maintenance:

- Introduction of the fuel levy in January 2009 (following a failed prior attempt to do so), which resulted from a successful stakeholder consultative process. The fuel levy initially generated about CVE300 million ($3.8 million equivalent) annually. The aggregated amount levied in 2017 totaled CVE639 million (around $7.1 million), and the 2018 amount is projected to be CVE 532 million (about $6.6 million equivalent), as expected by the IE.

- Introduction of performance-based maintenance contracts in Cabo Verde: Under the RSSP, a pilot program of six performance-based maintenance contracts was launched in September 2006 in Santiago, Santo Antão and Fogo, covering about 21 percent of Cabo Verde's road network (285 km). The contracts' period of performance ranged from 36 months (four of the contracts) to 60 months. By RSSP's completion in 2013, performance-based contracts covered 45 percent of the total national road network. These contracts were all financed by FAMR.

- As assessed by the World Bank[54], Cabo Verde has put in place an adequate institutional framework for efficient road management. This has been achieved through the creation of IE tasked with the management of the national road network, as well as the establishment of an autonomous road maintenance fund, FAMR, endowed with increasing funds generated through user fees. The efficiency of the IE has improved over time and has led to a stop in the further deteriorating of the road network condition.

To ensure consolidation of the developments in the country's road sector, the World Bank approved a subsequent project (TSRP), whose objective is to support GOCV's efforts to improve the efficiency and the management of the national road assets. The performance-based contracts piloted under the RSSP have been redesigned to include the rehabilitation of roads to maintainable standards, and 4 years of maintenance. Their coverage is being expanded to gradually increase over the TRSP implementation period from 44% (baseline) of the national network to 80% percent at project closing.

[54] World Bank. 2014. CV Road Sector Support Project (IDA-40640): Implementation Completion and Results Report (No. ICR2763, dated May 28, 2014).

During the December 2017 visit to Cabo Verde, the Evaluation Team was informed by IE that the redesigned performance-based contracts, now called REMADOR, currently covers all the country's national roads, including the three RBA roads (i.e., Roads 1, 2, and 4).

In summary, it seems fair to conclude that the current IE maintenance practices, supported by TSRP[55], will lead to a high likelihood that MCC's investment will remain adequately maintained for the life of the investment.

B) In cases where MCC invested in improving maintenance practices or included a maintenance Conditions Precedent in the Compact (applicable to Cabo Verde), what were the effects of those efforts and why? [Core]

1. What are main sources of revenues for FAMR? How stable and sustainable are the funds? What are the historical trends? What are the prospects of increasing the revenues?
2. How are the maintenance budgets planned?
3. How are the revenues split between maintenance and rehabilitation?
4. To what extent are the current revenues sufficient for funding routine maintenance and rehabilitation and improvement works?
5. What are the total maintenance needs of the road network?

The purpose of this research question is to understand the effects on the national road network maintenance of introducing FAMR and maintenance funding.

As noted in the Compact, the GOCV committed to maintaining a Road Agency and establishing a Road Maintenance Fund. The satisfactory completion of providing capacity building to the road agency - through a World Bank program - and establishment of an adequate funding of the Road Maintenance Fund were conditions precedent to certain MCC Disbursements. These two aspects are important determinants of the long-term viability and success of MCC's investments in roads, as they promote institutional responsibility and ownership of the roads. A dependable funding mechanism can facilitate employee retention, allowing for the acquisition of institutional and technical knowledge relevant to the agency's mission supporting the agency to expand. Adequate and regular funding also reduces uncertainty and allows the agency to make long-term plans, which promotes the identification and prioritization of ongoing issues that need to be addressed.

Some of these factors were evident in our interviews with staff during the Team's initial onsite visit in December 2017. For example, maintenance coverage of the roads is expected to increase from 89 percent to 92-93 percent next year, and pertinent explanations were provided regarding the process implemented to increase the coverage and why they were not able to immediately increase that percentage to 100 percent. In addition, weight restrictions related to vehicle weight are currently not implemented; however, draft proposals to address this issue are being circulated among the relevant agencies, and there seems to be some recognition that it is an important question to address.

[55] World Bank Transport Sector Reform Project (TSRP, Cr 52660-CV).

5.3 EVALUATION APPROACH

5.3.1 Existing Data

Substantial progress has been achieved in the institutional reforms in the road sector. The road maintenance fund, FAMR, became operational in 2006 in accordance with the MCC Compact Conditions Precedent. FAMR is designated to service approximately 425 km of roads—including the MCC-funded roads, which are part of the national road network. The fund generates about $6 million annually (the lowest amount generated was about $3 million), through a fuel levy of CVE 7 per liter (~7 USD cents) that was introduced in 2009. The fuel levy was in the meantime increased to CVE 8 per liter.

FAMR's maintenance budget is split on maintenance and improvement/rehabilitation of national roads (60%), emergency works (20%), and municipal and rural roads (20%). The later funds are transferred directly to local municipalities.

The Evaluation Team met with the Ministry of Infrastructure and Transport, former Director General of Infrastructure that worked together with MCA to manage MCC RBA Compact, IE and FAMR.

Documents provided by the IE include:

- REMADOR tender documents for island of Santiago (2018)
- Historical maintenance records for Road #1 (2015)
- Maintenance program (2010-2017)
- National Road Plan
- Maintenance cost for asphalt and cobblestone pavements (2017) (excel)
- Template for Bill of Quantities for REMADOR contracts (excel)
- Traffic counts on Roads 1, 2 and 4 (2008-2014) (excel).

In addition, FAMR provided annual reports from 2011 to 2016 to the Evaluation Team during the first mission.

5.3.2 Research Question 2A and 2B Methodology

Description of Methodology and Instrumentation: To analyze the formal and informal institutions in Cabo Verde, the team will employ a qualitative approach collecting already existing reports and conducting interviews with relevant stakeholders.

The team will conduct semi-structured interviews, a fairly open framework which allow for focused, conversational, two-way communication. Semi-structured interviews ensure that consistent data are collected, yet provide opportunities for an individual to offer their perspectives on the relative importance of any factor. The team will ask questions based on the evaluation questions described above and follow-up with relevant inquiries to obtain more specific information, such as examples of informal road maintenance processes diverging from formal ones and specific impacts of MCC's RBA on road maintenance activities.

5.3.3 Research Question 2A and 2B Data Collection Plan and Analysis

Data Collection for Research Question 2A: An indicative initial list of stakeholders is listed below in Table 5.1. The information from interviews will be supplemented by existing data on road maintenance practices and cost.

Table 5.1 List of Illustrative Stakeholders for KIIs for Question 2A

Interview Group	Discussion Topics	# of Interviews
Federal Government		
MIOTH	• Procedures for awarding contracts for road maintenance activities (any deviation of actual practices from official procedures) • Procedures and criteria for selecting roads sections that are candidates for routine maintenance works • Procedures and criteria for selecting roads sections that are candidates for periodic maintenance/ rehabilitation works • Type of maintenance works included in the REMADOR performance-based contracts • Supervision of maintenance works	1
IE		1
FAMR		1
Private Sector		
Maintenance contractors	• Procedures for awarding contracts for road maintenance activities (any deviation of actual practices from official procedures) • Type of maintenance works included in the REMADOR performance-based contracts • Supervision of maintenance works	3

The Evaluation Team will collect information on the decision-making process, i.e. what are the selection procedures for road maintenance and rehabilitation awards, what are the selection criteria used, and how are the maintenance treatments that need to be performed selected. Asphalt pavements have been introduced recently in Cabo Verde, so experience in their maintenance may be limited. However, the Evaluation Team will try to obtain information on the frequency and cost of maintenance treatments, as well as their effects in terms of IRI that can be achieved and deterioration rates following the treatment.

Data Collection for Research Question 2B: The list of stakeholders will include only Government entities, as presented in Table 5.2. The information from interviews will be supplemented by existing data on FAMR revenues and spending.

Table 5.2 List of Illustrative Stakeholders for KIIs for Question 2B

Interview Group	Discussion Topics	# of Interviews
Federal Government		
MIOTH	• Main sources of revenues for FAMR, historical trends and prospects of increasing the revenues • Process for maintenance budget planning	1
IE		1
FAMR		1

Interview Group	Discussion Topics	# of Interviews
	• Extend to whether the current revenues are sufficient for funding routine maintenance and rehabilitation • Type of maintenance conducted (routines, emergency, and periodic maintenance) • Total maintenance needs of the road network • Impact of MCC's assistance on maintenance budget and planning decisions	

The main objective of interviews will be to obtain information on maintenance budget planning, revenues and budget execution, as well as the extent of maintenance works that are currently covered and what are the funding gaps.

Rounds and Timing for Research Question 2A and 2B: Data collection for Research Questions 2A and 2B will be conducted in parallel with the Maintenance Cost Survey conducted as part of Research Area 1.

Staffing for Research Question 2A and 2B : Data collection and analysis for Research Questions 2A and 2 B will be completed by the Team Leader and Pavement Engineer.

Quality Assurance / Quality Control for Research Question 2A and 2B : To ensure high quality data collection, the interviews will be performed in Portuguese, with the assistance of an interpreter if needed (The Team Leader is a native Portuguese speaker).

Analysis for Research Question 2A and 2B: Qualitative data analysis will be used to analyze the data collected from the interviews. The Evaluation Team will classify, sort, and arrange information gathered to identify trends and examine the relationships in the data. The assessment of maintenance practices will be helpful to developing the RED model for the economic analysis of MCC road projects.

5.4 CHALLENGES

5.4.1 Limitations of Interpretation of the Results or Risks to the Study Design

The interviews conducted by the team may be influenced by response bias. The stakeholders often have a strong incentive to hide their nefarious activities, such as corruption. Similarly, stakeholders may be biased to answer in a certain way for social or political incentives. Consequently, they are likely to encounter difficulties in probing and understanding these issues, as well as ascertaining the true interests of the people engaged in such activities. For example, if not explained fully prior to the interviews, Cabo Verde's government staffs may want to provide positive results from the Compact to justify further investments from MCC.

Secondary data sources and KIIs will be essential for answering Evaluation Questions 2A and 2B. There is a risk that these documents may not be available to the evaluation team due to delay in locating the documents, loss of past records, or unwillingness of the stakeholders to share sensitive information. Even when the documents are available to the team, the documents may be an inaccurate representation of the actual practice.

VI. EVALUATION DESIGN – RESEARCH AREA 3: ROAD USAGE PATTERNS

6.1 EVALUATION QUESTIONS

A) Who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long does it take to move along key routes? [Core]

This evaluation question serves several purposes in the overall analysis. First, information gleaned from answering the question will help confirm/validate the identity of the main beneficiaries of the projects (Who is traveling on the road, what are they transporting). Second, the answer to the question on why people are traveling on the road (journey purpose) is an important input needed for the RED analysis in Research Area 1. Third, the information on fares and travel time will help validate the RED estimates, and could potentially be used in conjunction with them to identify profit/loss margins (which could be an indicator of market competitiveness), assess whether different operators are charging the same fares for given routes, and determine whether discounts are provided for certain classes of travelers (for example, regular/long-time customers, elderly, women or women with children etc.)

6.2 EVALUATION APPROACH

6.2.1 Existing Data

The team is not aware of any existing O-D survey data that would be useful for this analysis. The 2005 baseline assessment did not implement an O-D survey, but utilized a household survey[56] to capture information on access times and costs to markets and services and perceptions/expectations regarding transportation constraints and the MCC projects.

6.2.2 Research Question 3A Methodology

See section 4.2.6 and 4.2.7 above related to O-D Surveys and Public User Transport Surveys

6.3 CHALLENGES

6.3.1 Limitations of Interpretation of the Results or Risks to the Study Design

There are several challenges and limitations to the research being proposed for Research Area 3. First, the use of an O-D survey will limit the comparability of current results with baseline results since a household was used instead of an O-D survey for the baseline analysis. The baseline household survey was not only a different type of survey instrument, but it also collected information that will not be collected using an O-D survey.

Second, there is a risk of insufficient or unrepresentative samples. O-D surveys by their nature provide short-term snapshots of road usage and representativeness can be difficult to assess. Inevitably, the data collected will form a sample of the usage of the project roads. Care will be

[56] Estrategos Consultores Associados, SA, Estudo da Situacao de Referencia Socio-Economica, Relatorio Final, Abril 2005.

taken to ensure that the samples obtained are both sufficient in size, dictated by duration of survey and sample rate, and representative of usage of the roads being surveyed as much as possible.

VII. ADMINISTRATIVE

7.1 SUMMARY OF IRB REQUIREMENTS AND CLEARANCES

The Evaluation Team will prepare and submit an Institutional Review Board (IRB) application to an IRB registered with the Office for Human Research Protections with the US Department of Health and Human Services for approval of the research and data collection plan involving human subjects. The team expects the following data collection to involve human subjects:

- O-D survey
- Public Transport User survey

The application materials for IRB will include four sets of documents: 1) a copy of the EDR, 2) a copy of the survey protocol, 3) copies of all data collection instruments that will be used for the survey, and 4) a completed IRB application form summarizing protection of participant's rights and data safety. All materials will be translated into Portuguese by the Evaluation Team before submission and the interviews of road users will be conducted in Portuguese. The Team anticipates only minimal psychosocial stress and related risks for the research participants.

The selection of the participants to the O-D survey and Public Transport User survey will respect the principle of equity since participants will be randomly selected among the road users on MCC-funded road segments. The survey procedures will be based on the principles of voluntary participation and informed consent. Prior to participating in the survey, the road users interviewed will be given sufficient information on the objective of the survey and the use of the data collected to decide whether they wish to participate in the survey. The informed consent statement will closely follow the guidelines provided by MCC.

7.2 APPROVAL FROM LOCAL AUTHORITIES

For all collection of field data, the Evaluation Team will contact the necessary authorities early and work closely to ensure their timely cooperation. For data collection that requires traffic control or traffic diversion, the team will work with the MIOTH and the police to acquire official approval and cooperation well in advance. The team will work closely with other local authorities, such as the bus station authorities and toll stations as needed for approval prior to starting data collection.

7.3 DATA PROTECTION, ACCESS, AND DOCUMENTATION

The study will ensure that the confidentiality of information obtained from or about human participants is maintained. The Evaluation Team will ensure that the raw datasets are cleaned and de-identified closely following MCC's guidelines for public use of data. The obtained data will be stored in a secured server with limited access to key project personnel who signed the non-disclosure agreement.

The Evaluation Team will provide both a raw, non-de-identify dataset and a clean, de-identified dataset to MCC for public and internal use. The public-use dataset will be free of personal or geographic identifiers that would permit identification of individual respondents. Any additional variables that risk divulging the identity of individual subjects will be removed. In order to

facilitate access to and usability of data, all datasets delivered to MCC will be accompanied with completed documentation in the form of standardized metadata.

7.4 DISSEMINATION PLAN

A draft Evaluation Report will be submitted to MCC in November 2019. The Evaluation Team will also submit the final datasets (a raw dataset and a de-identified dataset) and the analysis files. Feedback from MCC and local stakeholders will be incorporated to produce the final reports in January 2020 and will include any Public Statement(s) of Difference/Support. Upon review by the Evaluation Management Committee (EMC), the Evaluation Team will present the results of the evaluation in Cabo Verde and Washington DC. The Evaluation Team will deliver the entire contents of the project library in good order properly indexed and marked in both digital and paper copy to MCC.

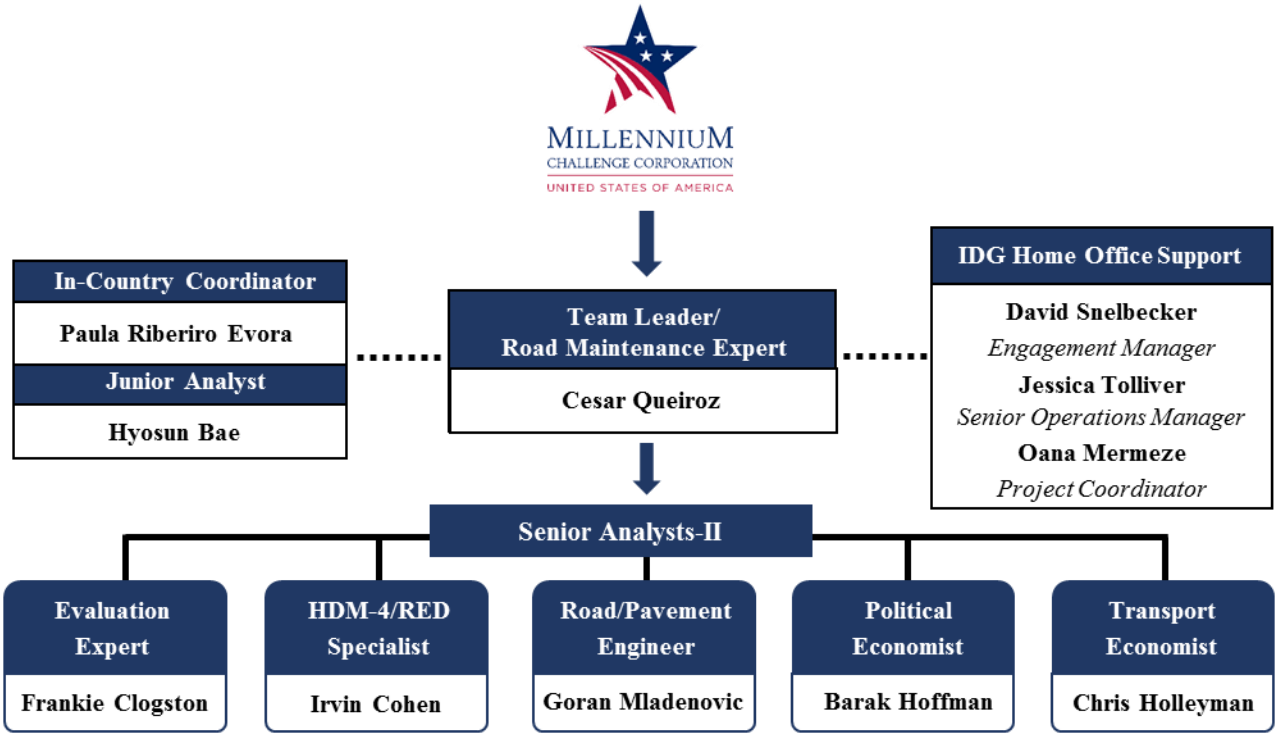
7.5 EVALUATION TEAM ROLES AND RESPONSIBILITIES

The Evaluation Team has seven key personnel that work closely together. The table (Table 7.1) below presents each of the key personnel on the Evaluation Team and their responsibilities. The support team will provide technical and administrative capacity to carry out the project activities and achieve MCC's goal and objectives. The diagram (Figure 7.1) below shows the organizational chart of the complete Evaluation Team.

Table 7.1 Evaluation Team and Responsibilities

Name	Labor Category	Responsibility
Cesar Queiroz	Team Leader / Senior Analyst II, Road Maintenance Expert	• Evaluation Coordination and Quality Control • Technical lead for Evaluation of Research Area 2: Maintenance
Irvin Cohen	Senior Analyst II, HDM-4/RED Specialist	• Technical lead for Evaluation of Research Area 1: Engineering Analysis and Economic Model • Technical support for Evaluation of Research Area 3: Road Usage Patterns
Frankie Clogston	Senior Analyst II, Evaluation Expert	• Technical lead for Evaluation of Research Area 3: Road Usage Patterns
Goran Mladenovic	Senior Analyst II, Roads/Pavement Engineer	• Technical support for Evaluation of Research Area 1: Engineering Analysis and Economic Model • Technical support for Evaluation of Research Area 2: Maintenance, especially for assisting analysis of road maintenance practices
Barak Hoffman	Senior Analyst II, Political Economist	• Technical support for Evaluation of Research Area 2: Maintenance,
Chris Holleyman	Senior Analyst II, Transport Economist	• Technical support for Evaluation of Research Area 2: Maintenance
Paula Evora	In-Country Coordinator	• Assist the team to arrange meetings with different stakeholders and facilitate the data collection procedure

Figure 7.1 Evaluation Team Organization Chart



7.6 EVALUATION TIMELINE & REPORTING SCHEDULE

The work plan for the evaluation is outlined below (Figure 7.2). The team expects the data collection to occur between November 2018 and August 2019. The plan accounts for each of the major deliverables along with the expected timeline of the evaluation.

Figure 7.2 Evaluation Workplan

Contract Start Date: 9/30/2017

WORK PLAN MCC CABO VERDE ROADS AND BRIDGES ACTIVITY

2017 — Oct: 6, 13, 20, 27; Nov: 3, 10, 17, 24; Dec: 1, 8, 15, 22, 29

2018 — Jan: 5, 12, 19, 26; Feb: 2, 9, 16, 23; Mar: 2, 9, 16, 23, 30; Apr: 6, 13, 20, 27; May: 4, 11, 18, 25; Jun: 1, 8, 15, 22, 29; Jul: 6, 13, 20, 27; Aug: 3, 10, 17, 24, 31; Sep: 7, 14, 21, 28; Q5

2019 — Q6, Q7, Q8, Q9

2020 — Q10, Q11, Q12

Activity	Responsible
Rapid Start-up and Reporting	
Key Personnel mobilized	Home Office Support
Kick-off meeting with MCC	TL, Home Office Support
Work Plan with Expected Delieverables	TL, CA, Home Office Support
Submit Monthly Progress Report	TL, CA
Phase I - Base Period (Research Design)	
Task 1: Assess Evaluation Plan, ERR Model and Existing Data & Documentation	
Conduct a comprehensive literature review research area methodology	Key personnel, JA
Assess the program logic, existing data, and ERR models, methodology to inform refining research questions	TL, EE, PE, HS, RE, JA
Submit Evaluability Assessment Report for feedback	TL, CA
Task 2: Develop Evaluation Design Report	
Submit SOW, Trip Report for each country visit	TL, CA, Home Office Support
Engage with country counterparts to establish a clear understanding of the project scope and refine research questions and methodologies	TL, TE, HS, RE, IC, CA/JA
Develop evaluation methodologies and evaluation questions for each research area	Key personnel, JA
Review in-country data to establish current values for economic parameters in HDM-4 on vehicle fleets relevant to the modeling exercise	TL, HS
Submit draft Evaluation Design Report	TL, CA
Conduct a workshop with local stakeholders to discuss research questions and methodology	TL, IC
Submit HDM-4 Calibration procedure to MCC for review and approval	TL, HS
Incorporate feedback from MCC and local stakeholders on the draft Evaluation Design Report	Key personnel, JA
Perform and submit Level 1 HDM-4 Calibration	TL, HS, CA
Submit Final Evaluation Design Report incorporating feedback from MCC and local stakeholders	TL, CA
Submit Nesstar Metadata for Evaluation Catalog entry	TL, Home Office Support, CA
Submit revised Phase II budget for MCC approval/technical directive	TL, Home Office Support, CA
Phase II - Option Period IB (Core Questions Only)	
Task 5: Develop Evaluation Materials	
Revise the Evaluation Design Report as evaluation develops	TL
Draft and submit data collection firm terms of reference	TL, HS, RE, TE, IC, CA
Identify local firms and solicit response from data collection firms and select a firm	TL, HS, TE, RE, IC, CA
Draft and submit draft survey questionnaires in English and Portuguese, data collection manuals, and other data collection instruments/protocols	TL, HS, RE, TE, IC, CA
Conduct a virtual review of data collection questionnaires, data collection manuals, and other instruments and protocols with local stakeholders	TL, IC
Incorporate feedback from MCC and local stakeholders on evaluation materials	TL, HS, RE, TE, IC, JA
Submit final versions of data collection instruments in Portuguese and English	TL, CA
Submit summary of pre-test and written review of back-translation	TL, CA
Submit IRB package including research protocol, informed consent statements, and other documents and approvals	TL, IC, CA
Task 6: Prepare and Undertake Data Collection	
Submit SOW, Trip Report for each country visit	TL, Home Office Support
Revise/update evaluation materials during data collection	TL, HS, RE, TE, IC, JA
Submit written minutes of meetings with data collection firms	TL, IC, CA
Train data collection firm enumerators	TL, EE, HS, RE, TE, IC
Conduct pilot tests for all data collection methods	TL, EE, HS, RE, TE, IC
Submit summary of enumerator training and pilot tests	TL, CA
Collect data and conduct field visits, quality assurance and quality control	TL, EE, HS, RE, TE, IC
Monitor data and process data entry	TL, EE, HS, RE, TE, IC
Submit Data Collection Report summarizing results, data collection implementation efforts, challenges encounters, and data quality control checks conducted	TL, CA
Submit revised Phase III budget for MCC approval/technical directive	TL, CA, Home Office Support

Contract Start Date: 9/30/2017		WORK PLAN MCC CABO VERDE ROADS AND BRIDGES ACTIVITY																																																											
		2017													2018																																							2019					2020		
		Oct				Nov				Dec					Jan				Feb				Mar					Apr				May				Jun					Jul				Aug					Sep											
		6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Phase III - Option Period IIB																																																													
Task 7: Develop Final Report, Data Files, and Data Documentation Package																																																													
Draft and Submit Data Package as per MCC Evaluation Microdata Guidelines including questionnaires, informed consents, the Data Package Worksheet, public-use and/or restricted-access microdata package, and analysis code	TL, EE, CA																																																												
Submit Data Collection Inventory with summary data and analysis	TL, EE, HS, RE, TE, IC, CA																																																												
Obtain satellite imagery of each road evaluated	EE, IC																																																												
Submit aerial imagery of each road overlaid with the IRI, traffic, O-D, Adjusted Structural Number, and any road condition evolution data	EE, TE, JA, CA																																																												
Submit draft Evaluation Report in English and Portuguese	TL, EE, HS, RE, TE, IC, JA, CA																																																												
Submit Final Evaluation Report including Public Statements of Difference/Support in English/Portuguese	TL, CA																																																												
Task 8: Disseminate Final Results																																																													
Submit SOW, Trip Report	TL, Home Office Support																																																												
Present results of the Final Evaluation Report findings at MCC headquarters and to other local stakeholders	TL, HS																																																												
Deliver entire contents of the project library in digital and paper copy for public distribution	TL, CA, Home Office Support																																																												

***Key Personnel** - TL: Team Leader/Road Maintenance Expert; EE: Evaluation Expert; HS: HDM-4/RED Specialist; RE: Road/Pavement Engineer; PE: Political Economist; TE: Transport Economist; IC: In-country Coordinator / ***Non Key Personnel** - CA: Contract Administrator; JA: Junior Analyst

** *Weeks/quarters marked in blue indicate a team member traveling to Cabo Verde,*
Weeks/ quarters marked in red indicate deadlines for written deliverables

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ANNEX I: ILLUSTRATIVE MANUAL TRAFFIC COUNT FORM

MANUAL CLASSIFIED COUNT (MCC)

Surveyor name:		Sheet no:	
Weather:	1 = clear; 2 = overcast; 3 = rain	Date:	

Direction of travel:	From:	To:

Time period 15 mins	Passenger: *Veiculos de Passagerios*						Freight: *Veiculos de Carga*				
	Car *Automovel*	4 wheel drive	Pickup *Hilux*	Minibus *Iasi*	Light truck *Dina*	Bus *Autocarro*	Pickup *Hilux*	Light truck *Dina*	Trucks 2 axle	3 axle	4+ axle
07h00-07h15											
sub total											
07h15-07h30											
sub total											
07h30-07h45											
sub total											
07h45-08h00											
sub total											
Hourly Total											
					single tyres on rear axle	< 30 seats		single tyres on rear axle	double tyres on rear axle	double tyres on rear axle	

ORIGIN-DESTINATION SURVEY Location: Name of interviewer: Date:

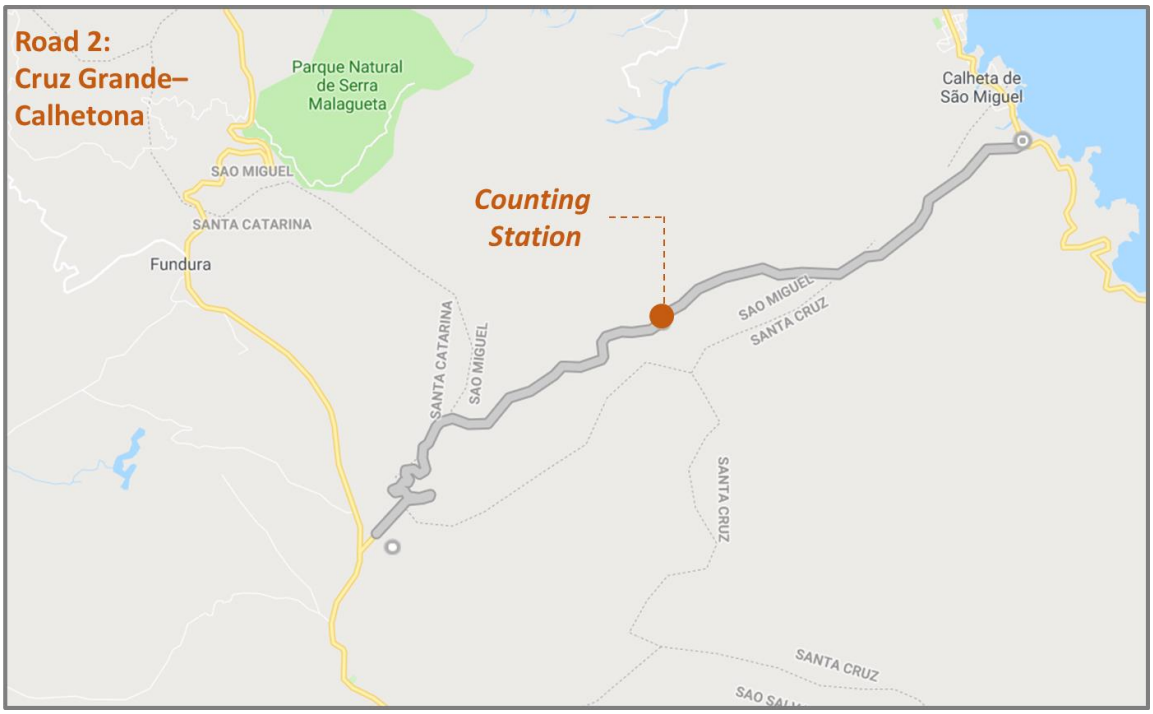
Weather: 1 = clear; 2 = overcast; 3 = rain	

1	2	3	4	5	6	7	8a	8b	9	10
Time	Vehicle Type	Origin	Destination	Trip Purpose	Trip Frequency	Vehicle Occupancy	Vehicle Capacity		Commodity carried	Load
	1 = car 2 = 4WD 3 = Hilux 4 = Iasi 5 = Dina 6 = 2 axle truck 7 = 3 axle truck	Name of place coming from (where journey first started)	Name of place going to (where journey finally ends)	1 = employer's business 2 = to/from work 3 = personal business 4 = tourism / recreation	1 = daily 2 = twice/week 3 = once/week 4 = twice/month 5 = once/month 6 = less often	Number of persons travelling, including the driver	*Buses only* Number of passengers	*Trucks only* Number of tonnes	*Trucks only* 1 = agricultural items 2 = fish 3 = agro-industrial items 4 = processed food, drink 5 = manufactured items 6 = construction materials 7 = POL fuels	0 = empty 1 = 1/4 full 2 = 1/2 full 3 = 3/4 full 4 = full

ANNEX II: ILLUSTRATIVE VOC SURVEY FORM

HDM-4 Input Data Item	**Passenger: *Veiculos de Passgerios***						**Freight: *Veiculos de Carga***				
	Car *Auto-movel*	4WD	Pick up *Hilux*	Mini-bus *Iasi*	Light truck *Dina*	Bus *Auto-carro*	Pick up *Hilux*	Light truck *Dina*	Truck 2-axle	Truck 3-axle	Truck 4+ axle
Vehicle characteristics											
Annual kilometres											
Annual work hours											
Number of axles											
Number of wheels											
Average life (years)											
PCSE											
Private use (%)											
Number of passengers											
Work related trips (%)											
ESAL factor											
Operating weight (tonnes)											
Vehicle unit economic costs											
New vehicle price											
New tyre price											
Fuel (per litre)											
Lubricating oil (per litre)											
Maintenance labour (per hour)											
Crew cost (per hour)											
Overheads (annual)											
Annual interest (%)											

ANNEX III: MAP OF TRAFFIC COUNT LOCATIONS[57]



[57] Please note that these are illustrative maps. The exact locations will be selected after discussion with the local subcontractor and MCC to ensure the safety and comfort of the enumerators.


Road 4:
Assomada–Porto Rincão
Counting Station 2
Counting Station 1
Cha de Tanque
Assomada
Assomada
Porto Rincão

ANNEX IV: PUBLIC STATEMENT OF DIFFERENCES AND SUPPORT

During the EDR Workshop conducted by the Cabo Verde to local stakeholders, participants were asked to send any Public Statement of Differences or Support to a provided IDG email address (procurement@internationaldevelopmentgroup.com). Two statements were received as below:

Statement from Norvia CV (translated from Portuguese) Date: February 27, 2018
I begin by congratulating you on the Workshop led in Praia on 20 February. My colleague Nuno Santos had the opportunity to attend and provided me with the slides of the presentation. As for the options for collecting data, based on our experience in Cape Verde, we consider that the standard approach is the one that best fits the technical means available in this country related to labor needs. It should however be noted that it is always possible to provide the means set out in Annex J, although the costs involved are significant. I leave only a small observation about the measuring deflection. If one chooses the mobilization of a FWD equipment (our company conducted such a survey recently and the costs were reasonable), we believe that a larger sample may be assumed (tests every 100 or 200m), since the cost per assay will be small after the equipment is already contracted.[58] I take this opportunity to once again present the availability of Norvia CV to support the IDG in carrying out field activities necessary to this study. Enclose some examples of works of the same nature carried out in Portugal, Angola, Senegal and Cape Verde. In Cape Verde, it is important to highlight a traffic study (survey O-D) carried out in 2010 and an inspection of the road network performed in 2014.
Response from the Evaluation Team: The evaluation team shared a draft request for information (RFI) to all firms requesting preliminary information from firms on data collection as proposed at the EDR workshop. The team encouraged all parties to respond to the RFI with any comments on the data collection methodology and draft cost information.

Statement from Hegel Fernades, Executive Manager, FAMR (translated from Portuguese) Date: April 17, 2018
Good afternoon First of all, we apologize for the delay in providing this statement. This is an e-mail to inform that we agree with the evaluation methodology of the MCA-CV I Roads & Bridges Project, presented at the workshop held on February 20 of this year.

[58] The IDG Evaluation Team has asked Norvia for cost information for conducting deflection measurements with both FWD and BB and we are waiting for the response.

Our only suggestion is to use disaggregated data at the time of the economic analysis of the project (Research Area 1). To do so, I believe that our National Statistics Institute (INE) would be of help (www.ine.cv).
Response from the Evaluation Team: The evaluation team has met with INE and will continue to work with INE to maximize using existing data. The team will attempt to use disaggregated data for gender, geographical area, and etc. to the extent possible for the evaluation.

ANNEX V: EVALUATION BUDGET

*The evaluation budget is removed from the report for the external version.